International
Marketing Information
Series

Global Market Survey

Laboratory
Instruments

U.S. DEPARTMENT OF COMMERCE
Domestic & International Business Administration
Bureau of International Commerce

GMS

International Marketing Information Series

This report is one of a series of Bureau of International Commerce publications focusing on foreign market opportunities for U.S. suppliers. The series is made available by the Bureau's Office of International Marketing in cooperation with the U.S. Foreign Service-Department of State. Most reports are based on research conducted by overseas contractors under U.S. Foreign Service supervision or by economic and commercial officers of the Foreign Service or Department of Commerce.

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As part of its marketing information program, OIM makes available to the U.S. business community, on a continuing basis, eight types of publications and reports.

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8. *International Marketing Events:* Brief market summaries in support of trade promotion events organized by the Office of International Marketing. Also, detailed calendars of upcoming events.

To supplement and up-date the marketing information available in this series, and for specific ordering information, we suggest that you telephone the nearest Department of Commerce District Office or the Country Marketing Manager responsible for the area or areas in which you are interested. A directory of these key people and offices is printed on the back cover.

Global Market Survey

Laboratory Instruments

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U.S. DEPARTMENT OF COMMERCE
Elliot L. Richardson, Secretary
Domestic and International Business Administration
Bureau of International Commerce
Office of International Marketing

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The Global Marketing Program

The Global Marketing Program is aimed at worldwide market penetration. It involves medium to long-term action by the Government in concert with 15 U.S. industrial sectors designated as "target industries".

The Program, developed and maintained by the Bureau of International Commerce, provides a wide range of U.S. government services focused on developing and expanding individual company export sales.

Fifteen American industries have been selected for inclusion in the Program. The industry selections were based on an assessment of their competitive advantages and growth potential in the world marketplace. The Office of International Marketing (OIM) solicits information and assistance from each key U.S. industry and related trade associations in planning the industry programs, in developing market research requirements, in selecting the country markets to be researched, and in determining the viability of Commerce-sponsored trade promotional events abroad.

A Global Marketing Program, combining the services outlined herein, is prepared for each target industry.

Global Market Survey

Foreign market research, conducted in 20-25 countries under the supervision of OIM and the U.S. Foreign Service—Department of State, is made available to U.S. firms in the selected industry. Additionally, a *Global Market Survey*, summarizing and analyzing the above comprehensive research, is published by OIM and distributed to U.S. industry.

Marketing Information and Counseling

Country Marketing Managers assist American companies in increasing their export business in specific countries and regions of the world by providing current marketing information and by working with individual companies in promoting their products.

Commerce District Office account executives provide Global Market Surveys to firms in the "target industry" and work with them in the preparation and implementation of individual company export marketing plans.

Trade Promotion Events

U.S. firms are invited to participate in a series of Commerce-sponsored commercial exhibitions, trade missions, seminars, and catalog shows scheduled for each industry. The U.S. Department of Commerce has been organizing these types of trade promotion events for U.S. industries for many years. The objective is to help U.S. manufacturers develop and increase their export sales. To obtain a copy of the schedule of upcoming events please write to the following address indicating the target industry of interest:

Office of International Marketing
Program Development, Room 4009
U.S. Department of Commerce
Washington, D.C. 20230

A schedule of other trade shows throughout the world sponsored by foreign organizations also is available by writing to the above address.

Below is a description of the types of trade promotion events organized by the U.S. Department of Commerce and the services available to U.S. participants:

Commercial Exhibitions at U.S. Trade Centers.—The first U.S. Trade Center was opened in London, England in 1961. There are now 12 U.S. Trade Centers around the world in which over 80 exhibitions of U.S. industrial equipment and products are conducted each year. Each exhibitor is furnished with a fully constructed exhibition stand, furniture, utilities and janitorial services. A catalog of exhibitors and an exhibition brochure is prepared and delivered to sales prospects throughout the marketing area. An all-media exhibition promotion campaign is conducted by U.S.

Target Industries

Avionics and Aviation Support Equipment (1975)
Process Control Instrumentation (1975)
Food Processing and Packaging Equipment (1975)
Air and Water Purification and Pollution
  Control Equipment (1976)
Laboratory Instruments (1976)
Business Equipment and Systems (1976)
Electric Energy Systems (1976)
Building Products and Construction Equipment (1976)
Communications Equipment and Systems (1977)
Computers and Peripheral Equipment (1973, 1977)
Health Care Industries Equipment (1973, 1977)
Graphic Industries Equipment (1974, 1978)
Electronic Industry Production and Test Equipment (1974, 1978)
Metalworking and Finishing Equipment (1975, 1978)
Electronic Components (1974, 1978)
(Actual and expected publication dates of Global Market Surveys for above industries in parenthesis)

A Global Marketing Program combining the services outlined herein is prepared for each target industry.

Commerce district office account executives provide

Program Development Room 4009

England in 1961. There are now 11 U.S. Trade Centers

Shipping and marking instructions are provided to exhibitors so that exhibit items can quickly clear customs enroute to the exhibition.

U.S. Pavilions at Major International Trade Fairs and "'Solo" Trade Fairs.—These exhibitions are organized and promoted in a manner similar to commercial exhibitions at U.S. Trade Centers, and U.S. exhibitors receive the same services from the U.S. Department of Commerce. Usually, U.S. pavilions are set up within major trade fairs in important foreign markets. On occasion, the U.S. Department of Commerce will independently organize a "solo" trade fair in a country where there is no U.S. Trade Center or major international trade fair but where prospects for U.S. exports are good.

Symposia and Seminars on Technological Developments.—These events are organized to introduce and explain new technology or new products to the market. The audience is comprised of engineers, scientists, technicians, managers, and directors from organizations which ultimately would purchase U.S. products incorporating the new technology. These events often are held in conjunction with commercial exhibitions or at meetings of professional organizations. Industry contributions are variable.

Trade Missions.—Organized either by the U.S. Department of Commerce or by an industry group or trade association, trade missions are supported by the Commercial Attaches at U.S. Foreign Service posts overseas. Appointments are made for mission members with important sales prospects and government decision-makers. Trade missions usually travel to several countries in a region with high sales potential for particular U.S. exports.

Catalog Shows.—These shows are organized by U.S. Department of Commerce and U.S. Foreign Service trade promotion specialists. Inquiries from prospective buyers and/or distributors are sent directly to each U.S. company promoting their products through these events.

Privately-Sponsored Events.—Single U.S. companies may hold product or service promotions in U.S. Trade Centers. These activities are sponsored, organized, and conducted by the companies themselves or their representatives in the country.

Jeep.—Joint Export Establishment Programs (JEEP) are tailor-made promotions designed to help small groups of U.S. manufacturers of related products to inexpensively penetrate new markets on a shared-cost basis.

Please contact the nearest U.S. Department of Commerce District Office or the appropriate Country Marketing Manager listed inside the back cover for more information on these events.

Other Marketing Assistance

The Office of International Marketing is responsible for developing an effective foreign trade promotion program related to U.S. industry's needs in most U.S. trade areas. Other action units within the Domestic and International Business Administration (DIBA) include: the Bureau of East-West Trade and the Commerce Action Group for the Near East, concentrating special expertise and business services on the trading opportunities in their respective geographic areas; the Office of Export Development, providing vital data on export opportunities and on potential overseas customers; and the Office of Field Operations, delivering all of these services to the doorstep of the American businessman through 43 District Offices.

To make effective use of these and other services contact your nearest Commerce district office.

Major Foreign Markets for Laboratory Instruments—An Executive Summary

Laboratory instrument sales in 16 leading countries should exceed $1.8 billion in 1979 (see figure 1) reflecting annual growth of 12% during the remainder of the 1970s. The predicted increases will follow on the heels of already vigorous growth experienced in recent years. These markets soared from over $650 million in 1972 to $1 billion in 1974.

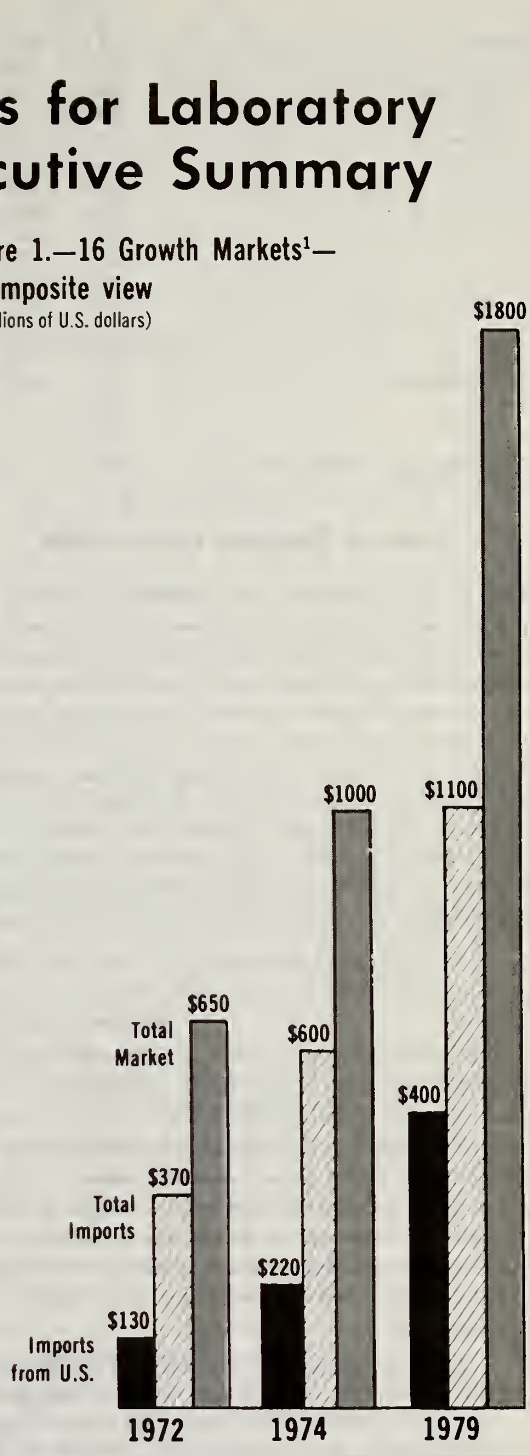
Foreign demand for laboratory testing equipment has increased substantially in recent years and this trend is expected to continue throughout the 1970s. Public concern for establishing higher standards in food, drugs, and consumer product safety has resulted in increased expenditures by governments and industries for expansion of test and evaluation laboratories. Government commitments to resolve energy and environmental problems also has resulted in increased allocations for related research and development. National health programs and greater emphasis on preventive medicine is also forcing accelerated spending on laboratory equipment. So too, is the demand increasing within traditional user industries including manufacturers of chemicals and pharmaceuticals, semiconductors, basic metals, and machinery as well as in government and independent materials testing laboratories.

The findings presented herein are the result of on-site research conducted for the U.S. Department of Commerce. The survey reveals that laboratories are under pressure to produce increasing numbers of analyses with greater efficiency and better accuracy. Scientists are looking toward more advanced instrumentation to accomplish some of these goals.

Although domestic manufacturers in certain foreign countries supply much of the local demand for laboratory instruments, the dependency upon imports has been steadily increasing to meet the more sophisticated needs. In 1974 total imports in the countries surveyed were valued at $600 million. They are predicted to exceed $1 billion in 1979, a 83% increase.

U.S. manufacturers have been particularly successful in penetrating the market. Over the period 1972-74 imports from the United States increased from 19% of total sales, or $130 million, to 22%, or $220 million. U.S. sales of nearly $400 million are projected for 1979 but could be significantly higher with increased marketing efforts by U.S. firms.

**Figure 1.—16 Growth Markets[1]—
A composite view**
(in millions of U.S. dollars)



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[1] Australia, Brazil, Czechoslovakia, Germany, Hong Kong, Iran, Israel, Italy, Japan, Mexico, Netherlands, Republic of China (Taiwan), Spain, Sweden, United Kingdom, Venezuela.

Source: Bureau of International Commerce, Office of International Marketing research reports.

Table 1.—The market for laboratory instruments by country, 1972, 1974 and 1979

(in millions of U.S. dollars)

	1972	1974	1979
Australia	22.4	39.0	58
Brazil	43.7	86.6	153
Czechoslovakia	28.9	41.6	66
Germany	144.2	217.7	282
Hong Kong	1.2	2.2	4
Iran	8.1	13.2	45
Israel	9.6	10.9	15
Italy	70.0	93.0	153
Japan	134.3	200.5	500
Mexico	10.4	17.0	27
Netherlands	35.8	66.2	114
Republic of China (Taiwan)	8.7	12.5	24
Spain	20.5	35.0	111
Sweden	46.0	74.0	136
United Kingdom	64.1	84.7	98
Venezuela	5.8	7.4	15
Total	653.7	1001.5	1805

Source: Bureau of International Commerce, Office of International Marketing research studies.

Sales of Selected Instruments

The U.S. Department of Commerce recently surveyed the market for 15 instrument types in each of 16 countries. Seven typical instrument types were selected for quantification of sales in 1974 and 1979 in the Commerce Survey. Figures 2 and 3 display the dramatic growth anticipated in the combined total market and in U.S. sales to 15 countries for each of these instrument types. Table 2 shows the 1979 forecasts of the total market size of these seven types for each country. Table 3 shows 1979 projections of imports from the United States for the same instruments and countries. Some of the highlights revealed in this analysis are as follows:

—Sales of gas chromatographs in the ***Republic of China (Taiwan)*** are expected to exceed $1 million in 1979 with U.S. manufacturers maintaining their 65% share of the market. Major purchases are planned by laboratories in the petroleum and synthetic fibers industry.

—The market for liquid chromatographs, particularly HPLCs, in ***Czechoslovakia*** is expected to grow from $400,000 in 1974 to $1 million in 1979 as modern methods are applied to basic research in high priority fields such as petrochemistry, biochemistry, biophysics, and medicine.

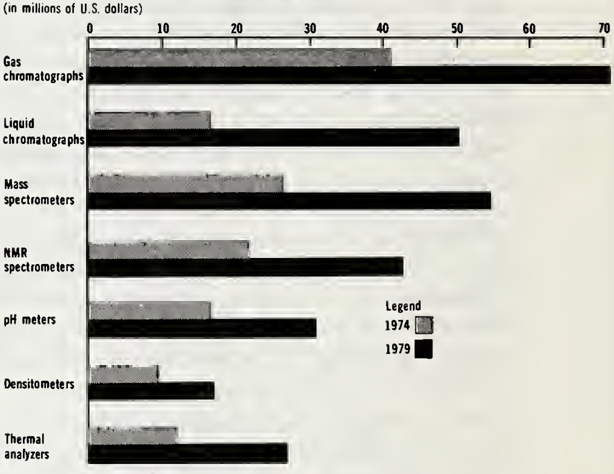
—Imports totaling $1.8 million provided 90% of the mass spectrometers sold in the ***Netherlands*** in 1974. U.S. firms led in sales and should improve their market share substantially. Imports from the U.S. are expected to advance from $600,000 in 1974 to $1.8 million in 1979

—The ***Italian*** market for MNR spectrometers is projected to rise from $850,000 in 1974 to $1.3 million in 1979, as their use becomes more widespread in laboratories of pharmaceutical manufacturers and producers of organic chemicals. U.S. firms supplied 70% of the Italian market in 1974 and this share should be maintained in 1979.

—***Israeli*** purchases of pH meters are forecast to increase by 15% annually between 1974 and 1979. Less expensive models are locally produced and U.S. manufacturers should expect some competition from domestic and other foreign firms.

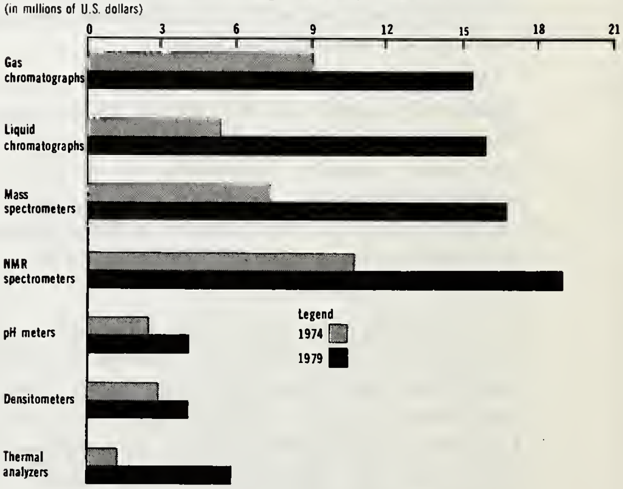
—Over 50% of the ***German*** market for densitometers consists of thin-layer and paper chromatography; the remainder is composed of scanners for electrophoresis. The scheduled modernization of medical laboratories research installations in Germany promises above average growth in sales of densitometers for clinical use. The market for densitometers is expected to expand dramatically through 1979 to reach $6

Figure 2—Projected growth potential for typical laboratory instruments in 15 foreign markets[1], 1974/1979



[1] All countries indicated in Figure 1 except Brazil

Figure 3—Projected U.S. sales of typical laboratory instruments in 15 foreign markets[1], 1974/1979



[1] All countries indicated in Figure 1 except Brazil

Table 2.—Typical laboratory instruments: Total market forecast, 1979

(in millions of U.S. dollars)

Product lines:	Germany	Italy	Netherlands	Spain	Sweden	United Kingdom	Australia	Japan	Hong Kong	Taiwan	Iran	Israel	Mexico	Venezuela	Czechoslovakia	TOTAL**
Gas chromatographs	9.0	3.4	5.0	1.0	2.2	6.7	2.4	34.5	.3	1.0	2.1	.8	.8	.7	1.6	71.1
Liquid chromatographs	3.0	1.1	2.0	1.3	1.2	3.5	2.4	32.1	*	.4	.5	1.6	—	.2	1.0	50.3
Mass spectrometers	11.0	.8	4.5	.8	1.5	4.0	1.9	25.9	*	.2	2.2	.5	.1	.5	.9	51.7
NMR spectrometers	8.0	1.4	3.0	.2	1.8	2.6	1.1	21.6	—	.1	1.4	.5		.1	1.2	12.8
pH meters	2.0	.6	1.6	.8	1.2	2.3	.9	17.2	*	.2	.2	.6	.8	2.0	.5	30.8
Densitometers	6.0	.4	1.8	.4	.6	.3	.5	5.2	*	*	.2	.1	.1	.2	1.0	17.0
Thermal analyzers	3.5	.8	1.0	.4	4.0	.3	1.1	14.7	*	.1	.2	*		.2	.1	26.7

*Less than $100,000.

**Sums of the country data by product line may not equal indicated totals because of rounding.

Table 3.—Typical laboratory instruments: Forecast of imports from U.S., 1979

(in millions of U.S. dollars)

	Germany	Italy	Netherlands	Spain	Sweden	United Kingdom	Australia	Japan	Hong Kong	Taiwan	Iran	Israel	Mexico	Venezuela	Czechoslovakia	TOTAL**
Gas chromatographs	2.7	.6	.8	.5	.5	1.7	2.0	1.7	.2	.7	1.7	.8	.7	.6	.2	15.1
Liquid chromatographs	1.2	.8	.9	.4	.3	1.4	1.9	6.4	*	.3	.1	1.6		.2	.1	15.9
Mass spectrometers	4.4	.2	1.8	.2	.9	1.6	.6	5.2	*	.1	.7	.1	.1	.5	.2	16.7
NMR spectrometers	4.0	1.0	1.5	*	.7	1.6	.6	8.6		*	1.1	.5		.1	.2	19.9
pH meters	.1	*	*	.2	.3	.5	.2	.9	*	*	.1	.3	.7	.7	*	1.1
Densitometers	2.4	.2	.3	*	.2	.1	.3	.1	*	*	.1	*	.1	.2	*	1.0
Thermal analyzers	1.1	*	.3	*	1.3	.1	.8	1.5	*	*	.1	*		.2	*	5.8

*Less than $100,000

**Sums of the country data by product line may not equal indicated totals because of rounding.

million. U.S. firms supplied over 50% of the market in 1974 with sales of $1.6 million.

The 21% average annual growth rate projected for sales in *Germany* of thermal analyzers between 1974 and 1979 is based on increasing application in the main user industries—building materials, metallurgical research and chemials. Thermogravimetric analyzers will account for half of the future sales in Germany and substantial investment will be made in differential thermoanalyzers.

Buyers for Laboratory Instruments

The values and percentage shares of total laboratory instruments sales by major buyers are shown in Figure 4 for 1974 and 1979 (projected). Projected growth of laboratory instrument markets overseas is keyed to expected increases in research and development (R&D) funds. Trade sources forecast annual R&D expenditures in the 16 surveyed countries should near $50 billion in 1979 or about 35% more than the $35 billion spent on R&D in the United States in 1975.

Similar to the United States, the central governments are the major source of R&D funds in most foreign countries (see table 4). Among the 16 countries surveyed only four (Czechoslovakia, Netherlands, Sweden, and Japan) received less than half of their R&D funds from the government. On the other hand, in most of the less industrialized countries the government contributed 70% or more to R&D expenditures. In Mexico, the Government supplied 85% of R&D funds in 1974; Spain (85%), Venezuela (81%), Republic of China (80%), Brazil (72%), Hong Kong (71%) and Australia (70%). The central government provided the bulk of R&D funds even in highly developed economics such as the United Kingdom (58%), the United States (52%), and Germany (51%).

Whereas government is the principal supplier of R&D funds, industry is the primary user of monies. Industrial expenditures should account for more than half, nearly $28 billion, of the total R&D budget in 1979. In developed economies, such as Germany, United Kingdom, Japan, Netherlands, Sweden, Czechoslovakia, and Italy, industry takes the initiative in R&D and utilizes the majority of available funds. In most of the less industrialized nations, the central government or educational and nonprofit institutions account for the majority of R&D expenditures. The national governments in Spain, Australia, Republic of China, Mexico, and Brazil retain the greatest share of the R&D budget. Educational and nonprofit institutions are the center of R&D activities in Hong Kong, Israel, and Venezuela. In each of these three countries substantial grants come from the central government and go to the universities to support R&D programs.

Industrial laboratories.—Sales to the industrial sector are expected to climb from $531 million in 1974 to

$955 million in 1979, representing an average annual growth rate of 12.4%. Laboratory expenditures are expected to more than double during the same period, rising from over $9 billion to $19 billion. Industry is increasing its laboratory expenditures in response to increased competition and growing consumer demands for new and better products. Many managers feel that R&D budgets should be increased during economic recessions so that when the economy picks up, the industry will be in a position to offer new products. R&D funds utilized by industry are expected to grow by an average of 9.8% annually between 1974 and 1979 in the 11 surveyed countries for which data is available.

The chemical industry is the largest industrial purchaser of laboratory instruments. Sales of laboratory instruments are expected to grow by 12% annually from nearly $126 million in 1974 to about $222 million in 1979. Significant in the planned purchases to be made are:

Activation analysis equipment
Air sampling analysis equipment
Gas chromatographs
Atomic absorption spectrophotometers
Fluorimeters
Energy dispersive X-ray analyzers
Oxygen analyzers
Infra-red spectrometers
Automatic analyzers
NMR spectrometers
Polarographs

Each Country Market Survey on laboratory instruments gives examples of the types of research activity being undertaken. Two examples are:

—In the *Netherlands*, emphasis will focus on the electrochemistry of molten salts and complex formation in concentrated solutions; thermodynamic stability of stationary states in continuous reactive systems; development of measuring methods for ion-Newtonian liquids; nitrogen components in natural oils; biodegradation of hydrocarbons and mineral oils; and mechanism and cybernetics of the disproportion of olefins.

—In *Germany* the chemical industry is frequently funded by the Government to conduct research. Recent emphasis has been placed on the development of environment-protection technologies. Other major projects in progress in 1975 include: coal liquefaction; electro-chemical synthesis of organic sulfones; distribution of pesticides in the soil-plant system; synthesis of carbonyl compounds; high temperature pyrolysis processes and recycling of used, high-temperature reactor elements.

The primary metals industry is also a major purchaser of laboratory instruments. Sales to this industrial sector are expected to exceed $87 million in 1979 in the surveyed countries. Trade experts foresee growth in the market sector averaging 11.8% annually between 1974 and 1979. At the same time, laboratory expenditures should grow from nearly $600 million to over $1.2 billion.

Instruments needed by the industry include:

Energy dispersive X-ray and multichannel X-ray spectrometer
Computer-controlled X-ray diffractometers
Ion-sensitive electrodes
Dilatometers
Activation analysis equipment
Differential thermal analyzers
Thermal gravimetric analyzers
Electron microscopes
Penetrometers
Gas analyzers
Magnetometers

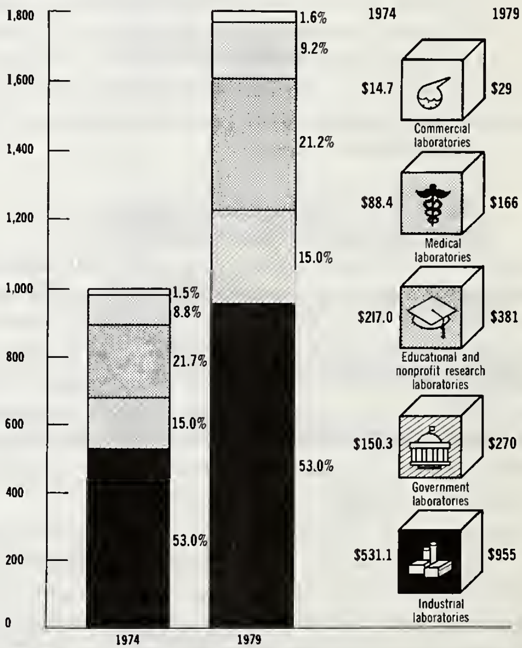
The primary metals industry in several surveyed countries is carrying on extensive R&D programs.

—The *Japanese* primary metals industry, with the aid of a government subsidy, is developing a nuclear reactor to be used in the manufacture of steel. The process involves utilization of the heat in the helium coolant used in a multi-purpose high-temperature gas cooled reactor.

—The Government of *Sweden* is coordinating and providing partial funding for a 10 company

Figure 4.—The Market[1] for Laboratory Instruments by Major Buyers, 1974 and 1979

(in millions of U.S. dollars)



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[1] All countries listed in figure 1.

Table 4.—Research and development funds by source and use 1974 and 1979
(in millions of U.S. dollars)

	1974				1979			
	Government	Industry	Educational & nonprofit Institutions	Total	Government	Industry	Educational & nonprofit Institutions	Total
Australia[1]				374				1,610
Source	260	105	9		1,481	110	19	
Use	203	95	76		890	410	310	
Brazil				499				1,509
Source	359	70	70		1,077	216	216	
Use	179	150	170		538	555	416	
Czechoslovakia				1,232				2,000
Source	512	720	—		815	1,185		
Use	129	1,067	36		230	1,710	60	
Germany				8,760				12,940
Source	4,460	4,300	—		6,920	6,020		
Use	1,050	4,900	2,810		4,680	7,250	1,010	
Hong Kong				7				11
Source	5	1	1		7	2	2	
Use	2	1	4		3	1	7	
Israel				160				207
Source	86	24	50		97	39	71	
Use	25	54	81		29	60	118	
Italy				1,328				2,230
Source	672	634	22		1,150	1,000	80	
Use	283	703	342		330	1,200	700	
Japan[2]				8,200				19,100
Source	2,300	4,800	1,100		5,400	11,200	2,500	
Use	700	4,900	2,600		1,600	11,500	6,000	
Mexico				152				245
Source	129	23	—		208	37		
Use	56	43	53		90	69	86	
Netherlands				1,360				1,950
Source	630	730	—		850	1,100		
Use	290	790	280		400	1,170	380	
Republic of China (Taiwan)				35				56
Source	28	2	5		45	3	8	
Use	18	2	15		28	2	26	
Spain				683				1,983
Source	582	101	—		1,690	293		
Use	463	178	42		1,342	518	123	
Sweden[2]				740				1,540
Source	308	425	7		585	940	15	
Use	160	510	70		300	1,110	130	
United Kingdom[2]				3,355				3,960
Source	1,943	1,395	17		3,160	1,775	25	
Use	1,066	2,068	221		1,470	2,200	290	
Venezuela				158				310
Source	128	20	10		245	15	20	
Use	40	34	84		80	80	150	

[1] 1969 data instead of 1974.

[2] 1973 data instead of 1974.

Source: Bureau of International Commerce, Office of International Marketing research report.

joint research project involving potential industrial uses of hydrometallurgic phenomena. This program was prompted by the current interest in the conservation of materials through recycling.

Other industrial sectors which are important end-users of laboratory instruments include oil and gas extraction; food products; petroleum, rubber and plastic products; stone, clay, and glass; fabricated metal products; and transportation equipment. Major projects in these industries include the following:

—Fiat of *Italy* has several major chemical and ecological R&D projects underway. The firm is investigating lubrication and combustion, electrochemistry, nonpolluting paint and other protective coatings, and industrial pollution control techniques, all related to automotive application.

—An upsurge in public concern about the quality of the foods offered for sale in *Australia* has accompanied the rapid rise in consumption of processed foods. The food products industry has been accused of failure to perform sufficient analytical tests to determine the nutritional value of its products and of laxity in the entire area of quality control. The government has responded by formulating more stringent regulations covering plant sanitation, standards of wholesomeness, and product labeling. Most companies will have to upgrade their laboratory facilities to satisfy the new requirements.

—The Iran's oil and gas extraction industry has centered its research activities on: exploration to increase the known reserves; product and raw material quality control; studying the effectiveness of oil mulches; and the measurement of air and water pollution resulting from oil and gas extraction.

Educational and Nonprofit Laboratories.— These facilities constitute significant end-user markets for laboratory instruments. Total scientific and educational expenditures were estimated at close to $3.3 billion in 1974 and should exceed $6.1 billion in 1979. Sales to these institutions in the countries surveyed, are expected to exceed $380 million in 1979, maintaining an average annual growth rate of 12% over the 1974 level of $217 million.

Several nations are placing increased emphasis on education in the natural and life sciences. Many developing countries are stressing scientific study to develop an indigenous staff of scientists capable of establishing a research base in the country. These nations want to initiate R&D programs that would permit conversion of natural resources into finished products for sale on the world market.

A number of developed nations are also beginning to stress the sciences in their educational systems. During the 1960s and early 1970s, public attention was focused on overcoming social problems. Educational institutions responded by restructuring their curricula to emphasize social studies. Instruction in the natural and life sciences suffered as a result. Public attention, partly because of the energy shortage,is again centered on technological improvements and research in the natural and life sciences. School systems are gearing to reflect this change by allocating additional funds to support scientific programs. Educational instrument sales will be generated by those institutions that intend to upgrade existing laboratories as well as equip new facilities.

Many governments are implementing plans to improve educational facilities.

—The Government of ***Hong Kong*** estimates that recurrent and capital grants to the Hong Kong University, The Chinese University of Hong Kong, and the Hong Kong Polytechnic Institute grew from more than $20 million in 1973 to $32 million in 1975. Future expansion plans include Phase II of the Chinese University Science Center, expansion and improvements to the Morrison Hill Technical Institute, and new technical institutes at Cheung Sha Wan, Kwun Tong and San Po Kong.

—*Sweden* adopted a policy of university decentralization in 1973. Branches of the universities and technical colleges at Stockholm, Gothenburg, Uppsala, and Lund are being established throughout Sweden, creating a need for new scientific laboratories and related equipment

Table 5.—Laboratory expenditures and purchases of instruments by end user classification 1974 and 1979

(in millions of U.S. dollars)

	Laboratory Expenditures		Purchases of laboratory instruments	
	1974	1979	1974	1979
Government	2149	4024	150.3	270
Educational and nonprofit institutions	3298	6149	217.0	381
Independent commercial laboratories	162	348	14.7	29
Medical organizations	1625	3206	88.4	166
Industry	9052	18807	531.1	955
Oil and gas extraction	83	183	10.2	19
Food products	308	609	22.0	39
Chemicals	2045	4084	127.5	222
Petroleum	168	341	15.5	31
Rubber and plastic products	175	325	15.8	28
Stone, clay and glass	182	383	9.7	17
Primary metals	598	1211	49.6	87
Fabricated metal products	410	752	33.7	61
Transportation equipment	1440	2777	55.2	113
Other	3643	8142	191.9	338
Total	16286	32534	1001.5	1801

Source: Bureau of International Commerce, Office of International Marketing research studies.

at each site. The Government recognizes the need to replace obsolete equipment in existing laboratories and perhaps enlarge the facilities devoted to laboratory work, and accomodate more students.

Most of the developed countries have large nonprofit scientific research organizations responsible for a substantial portion of the R&D projects performed in the country. In many of the developing countries, the universities are the primary research centers.

The most important nonprofit scientific research organization in *Germany* is the Max-Planck-Gesellshaft. It had a $220-million budget in 1973. This organization comprises 48 institutes-24 biological-medical, 15 physical-technological, and 9 in the humanities. Second in significance is the Fraunhofer-Gesellschaft with 11 institutes and a 1973 budget of $12 million.

The universities perform most of the research activities in *Venezuela*. The largest individual institution is the Instituto Venezolano de Investigaciones Cientificas (IVIC), a training center for graduate work in science. IVIC operates departments in biophysics and biochemistry, microbiology and cellular research, physics and chemistry, petroleum and petrochemicals, engineering and ecology, neurobiology, experimental medicine, anthropology and nuclear technology. Three of the largest laboratories, outside the IVIC, are located in the Universidad de los Andes in Merida, the Universidad Simon Bolivar, and the Universidad Central de Venezuela. The latter has a sizable hospital laboratory engaged in medical analyses.

Sales to government laboratories in the countries surveyed are expected to advance from over $150 million in 1974 to $270 million in 1979 at an average annual increase of 12.5%. All laboratory expenditures are forecast to grow at a slightly faster rate, 13.7% annually, rising from over $2.1 billion in 1974 to $4 billion in 1979.

Government laboratories are engaged in a wide variety of research activities. Defense research is usually performed by the national government or under its auspices. Both national and local government agencies also are involved heavily in energy research, nuclear science, product and process safety testing, pollution control, oceanography, and agricultural research.

In the developing countries the scope of research activities carried on by government laboratories is broader than that undertaken in developed economies. Major research programs in developed countries tend to be in response to public pressure. Consumer demand for higher product standards and a cleaner environment will mean expansion of many government agencies. In developing countries, the government takes a more active role in the development of industries vital to the economic prosperity of the nation. Often research on basic industries such as petroleum, chemicals and agriculture is under the direct control of the government.

Descriptions of some of the major research activities presently undertaken by the various government agencies are outlined below.

Government-owned companies under contract to the Army and the Navy perform the bulk of the military weapons R&D in ***Spain***. The Empresa Nacional Santa Barbara de Industries Militares S.A. is developing a version of the multibarreled Gatling gun for anti-aircraft defense use. The radar-controlled computerized aiming system for this gun was developed by the Army's Ordinance Laboratory.

The numerous government testing and evaluation laboratories in ***Japan*** investigate areas such as chemicals; foodstuffs; radio-active substances; water, air, and soil pollution; and safety testing of materials.

Brazil's government institutes are directly responsible for research in nuclear technology, aerospace, oceanography, petroleum and petrochemicals, electrical energy, and minerals resources. Programs are being expanded in each of these areas and several large new facilities are planned.

Clinical and Medical Laboratories.—Growing emphasis on diagnostic and preventive medicine has resulted in a need for larger and better equipped clinical and medical laboratories. Instruments will be purchased in conjunction with the expansion of laboratory facilities. Sales of instruments to the end-user sector were estimated at over $88 million in 1974 in the surveyed countries and trade sources predict that the market will reach $166 million by 1979. Total laboratory expenditures should exceed $3.2 billion in 1979, double the 1974 level of $1.6 billion.

Foreign clinical and medical laboratories will require specific types of laboratory instruments. Demand is expected to be particularly high for: amino acid analyzers, automatic analyzers, gas and liquid chromatographs, pH meters, balances, centrifuges, colorimeters, electron and proton microscopes, and spectrometers.

Market factors of significance to U.S. manufacturers of laboratory instruments include:

In *Czechoslovakia*, the number of medical examinations performed is increasing steadily and laboratory technicians are scarce. Consequently, diagnostic laboratories are planning to replace manually-operated instruments with automated or semiautomated types.

Future growth of laboratory instruments sales is closely tied to hospital construction in the ***United Kingdom***. About five new hospitals should be built over the next 5 years. Instruments to furnish

The Product Category-Laboratory Instruments

The product category, laboratory instruments, comprises all instruments used in a research or testing laboratory to test, evaluate, analyze or measure the chemical composition of materials, the physical properties of materials or the performance of materials or processes. Under the Brussels Tariff Nomenclature (BTN), the Standard International Trade Classification (SITC) and the Standard Industrial Classification (SIC) systems of commodity classifications, there are no categories exclusively limited to laboratory instruments. Statistics used in the survey are trade source estimates based on the following classifications.

	BTN	SITC	SIC
Hydrometers, thermometers, pyrometers, barometers, hydrometers and similar instruments, nonelectric and nonelectronic.	90.23	861.96	38293
Instruments for measuring or controling the flow, depth, pressure or other variables of liquids or gases	90.21	861.97	38321
Instruments and apparatus for physical or chemical analysis, nonelectrical and nonelectronic	90.25	861.98	38321
Electrical and electronic measuring analyzing or automatically controlling instruments and apparatus	90.28	729.52	38292 38321 38253
Centrifuges and filtering and purifying machinery for liquid and gases, fluids and gases.	81.18B	719.23	38112
Microscopes and diffraction apparatus, electron and proton	90.11	861.33	38321
Compound optical microscopes, except electron and proton	90.12	861.31	38321
Galances, laboratory, except electrically or electronically operated	90.22	861.95	38112
Mechanical appliances for testing physical properties industrial materials	90.22	861.95	38292

the laboratories in these facilities should cost about $750,000. The National Institute for Medical Research has allocated $2.5 million for renovation of its facilities.

Independent Commercial Laboratories.—While the establishment of independent commercial laboratories is just beginning in many of the surveyed countries, their importance as an end-user of laboratory instruments is readily recognized. Instrument sales to this sector reached almost $15 million in 1974 and are predicted to exceed $29 million by 1979. During the same time period, laboratory expenditures should more than double, increasing from $162 million to $348 million.

As the salaries of skilled technicians and the cost of maintaining top-quality laboratories rise, more managers are closing under-utilized facilities in favor of sending material to independent commercial laboratories for analysis. This trend began in the developed countries. By 1974, Japan, Germany, Italy, Brazil, Sweden, the United Kingdom, and Australia had well established networks of commercial laboratories performing a wide variety of analysis. Commercial facilities in these countries reported expenditures totaling $1 million or more for laboratory instruments in 1974. By 1979, almost all of the surveyed countries are expected to have commercial laboratories in operation.

A few of the significant developments in this sector are mentioned below.

—Independent food chemistry laboratories in *Germany* typically test food samples or study harmful substances in foods for companies that may be engaged in disputes with official health agencies. They also supervise and control production for small food manufacturers who cannot afford their own laboratories.

Industry in the *United Kingdom* is expected to turn to independent laboratories for help in handling their increased workload, particularly in the field of pharmacology, toxicology, and applied biology.

Competitive Assessment

Many American manufacturers of laboratory instruments are expanding their sales horizons to include a number of foreign markets. They are finding that the stiffest competition for sophisticated instruments is offered by European firms. U.S. and German manufacturers sell a wide range of laboratory instruments to all parts of the world. Switzerland is particularly known for its precision balances. Japan, long noted for its quality optical instruments, is now price competitive in other types of laboratory instruments.

Leading world exporters of laboratory instruments have been effectively marketing their products for some time. They rely heavily on foreign sales to maintain economies of scale in production and to maximize their return on development costs. To insure adequate market penetration they maintain aggressive representation through a number of capable sales representatives and maintain reliable after-sales service and spare parts supports. Most devote considerable attention to developing new contacts and promoting new products and developing new applications for their instruments.

In several of the developing countries surveyed, local manufacturers offer strong competition in the simpler laboratory instruments. Domestic firms have a number of advantages over foreign suppliers such as lower prices, tariff protection, import licensing, short delivery times, prompt parts supply and repairs. However, the technology gap between locally produced and imported equipment generally is wide, leaving each with its distinct market. Specialized and advanced types of instruments are predominantly imported from various European and American makers.

Foreign customers report that American companies could increase their sales through a more concentrated marketing effort. Some U.S. companies, recognizing this, have sharply increased their activities in the international market.

The following basic steps are suggested for firms seeking to initiate penetration in foreign markets:

- Establish effective sales representation abroad.
- Participate in overseas trade exhibitions.
- Provide for sales and technical literature written in appropriate languages.
- Advertise in trade publications and contribute articles to trade journals.
- Maintain delivery commitments and effective after-sales service.

The Department of Commerce can assist U.S. manufacturers of laboratory instruments in capturing a greater share of the overseas market. Export information services supplied by the Department are listed and explained later in this survey. Companies interested in obtaining more information on the listed programs should contact the nearest Department of Commerce District Office.

Country Market Surveys

Surveys on 16 primary markets for *Laboratory Instruments* are contained in this section. These surveys are based on comprehensive market studies conducted for the U.S. Department of Commerce, Office of International Marketing in the respective countries.

The *Country Market Surveys* cover:

Market Size

- Narrative and statistical presentation of size of the market, including historical and projected growth, and key market trends.
- A discussion of sales of laboratory instruments to the major end users.

Competitive Environment

- Discussion of imports and the share of the import market held by U.S. firms.
- Review of the competitive position of domestic and third country suppliers.
- A discussion of approximately 10 selected instruments.

Major Purchasers

- A discussion of the country's general research and development (R&D) activities, including an analysis of funds in 1974 and 1979.
- A discussion of the most important end-user sectors. Highlights of major expansion programs.
- Identification of equipment expected to be in high demand by each sector.

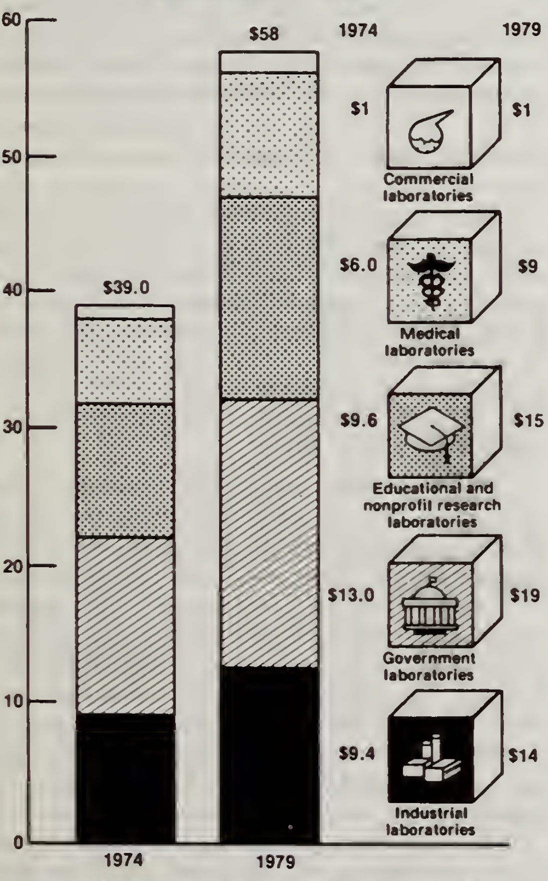
Trade and Technical Regulations

- The range of import tariff rates applicable to laboratory instruments and relevant nontariff barriers.
- Special technical standards which would apply to imported laboratory instruments.

Australia

Planned construction of new laboratories and expansion of existing facilities at Australia's government research institutes, universities, and industrial plants will entail substantial spending for additional laboratory instruments. Accordingly, the Australian market for such instruments is expected to amount to $58 million[1] in 1979, reflecting an average yearly growth of 10.4% from 1975's level of $39 million (see figure 1). Laboratory instrument sales rose by 18.4% per year between 1972 and 1975 (see table 1).

Figure 1. Australia: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report, values based on Australian trade source estimates

An analysis of proposed budgets suggests that total expenditures by Australian laboratories may climb by an average of more than 11% annually between 1974 and 1979, reaching $164 million at the end of that period. The biggest increases are likely to occur from late 1976 onward, as current efforts to stimulate the private sector of the country's economy begin to take effect.

Expenditures by government-administered laboratories may rise by more than 10% per year between 1974 and 1979. Publicly owned research facilities are expected to allocate nearly $19 million from their 1979 budgets for the purchase of laboratory instruments. This equipment will be used for the further study of animal health and other scientific subjects related to the nation's economic development.

Universities are slated to receive increased government funding designed to upgrade scientific education at the graduate level, through greater emphasis on basic and applied research. Hence, educational and other nonprofit research laboratories may spend more than $15 million for laboratory instruments in 1979, nearly double their 1974 outlays.

Australian industry—particularly those sectors producing consumer goods—is under public pressure to improve quality control and, in the case of food, to adhere to stricter standards of purity and wholesomeness. Many companies are expected to expand their scientific test and evaluation capabilities. Also, laboratory facilities will constitute an important part of the major petrochemical complex scheduled to

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[1] All values are shown in U.S. dollars. Local currency data converted at the following exchange rates: U.S. $1.00 = A$ 0.840 (1972); A$ 0.704 (1973); A$ 0.671 (1974); A$ 0.758 (1975 and subsequent years).

Table 1.—Australia: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	8.9	14.7	15.0
Imports	23.5	40.1	39.1
Exports	10.0	15.8	15.4
Market size[1]	22.4	39.0	38.7

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[1] Market size equals production plus imports minus exports.
Source: Value based on Australian trade source estimates.

be built in southern Australia later in the decade. Taking these and other factors into consideration, market analysts estimate that Australian purchases of laboratory instruments for industrial use may reach $14 million in 1979, almost 50% above 1974 expenditures of $9.4 million.

Competitive Environment

Equipment imported from the United States, Europe, and Japan supplies approximately 90% of the Australian market for laboratory instruments. Sales of imported laboratory instruments are forecast to exceed $58 million in 1979, for a 7.7% average annual growth rate over the 1974 level of over $40 million.

American manufacturers won a 50% share of Australia's market for imported laboratory instruments, selling approximately $20 million in 1974. Trade sources report that the increase over the 1972 market share of 42% resulted from superior marketing and promotional efforts, especially as applied to the more sophisticated instruments, combined with advantages gained through currency realinements (see table 2). Reportedly, however, customers who bought American-made laboratory instruments during the past few years are expressing disappointment concerning durability, availability of parts, and maintenance service. These end-user attitudes, coupled with the vigorous sales efforts being made by established European and Japanese suppliers, could damage the U.S. competitive position somewhat. Projections for 1979 show imports of American-made laboratory instruments at close to $28 million, or 48% of total imports.

Australian users have a high regard for the technical quality and accuracy of U.S. laboratory instruments. The fact that a large number of prominent U.S. manufacturers of laboratory instruments are represented by Australian agents has helped increase sales, by making their products relatively easy to obtain.

Research recently conducted in Australia for the U.S. Department of Commerce, Office of International Marketing, analyzed the market for 10 selected instruments (see table 3). Several of these laboratory instruments should sell particularly well in Australia during the 1975-79 period. Australian imports of ***automatic analyzers*** from the United States may climb from $1.5 million in 1974 to $2 million in 1979. U.S. firms such as Technicon Instruments Corp. are by far the leading suppliers to Australia of this type of apparatus. Hospitals are the major customers; however, industry is expected to increase its use of automatic analyzers—especially for repetitive analyses in quality control laboratories.

American manufacturers such as Hewlett Packard Co., Perkin-Elmer Corp., and Varian Associates are Australia's leading source of ***gas chromatographs.*** The United States accounted for approximately 80% of 1974 imports of such instruments. This share may rise slightly during the 1975-79 period, bringing U.S. sales of gas chromatographs to nearly $2 million. Demand for these instruments, used extensively in industry, education, government, and medical laboratories throughout Australia, is climbing steadily. Dual column/flame ionization detection chromatographs are especially popular with Australian users, but nitrogen-phosphorous detectors are gaining acceptance for their greater sensitivity and ease of use.

Imports of ***liquid chromatographs*** from the United States are expected to more than double during the next few years, climbing from $810,000 in 1974 to more than $1.9 million in 1979. Since they can be used to evaluate a wider range of chemical compounds than can gas chromatographs, liquid chromatographs are likely to be in great demand among Australia's scientists. High-performance liquid chromatographs (HPLC) are valued for use in assaying the quality of ores. Spectra-Physics and du Pont are the principal suppliers of American liquid chromatographs to the Australian market.

Thermal analyzers—both differential scanning calorimeters and differential thermal analyzers—are widely used in Australian industry. Purchases from U.S. manufacturers (such as Perkin-Elmer Corp. and du Pont) account for 75% of the market. Trade sources estimate that total sales of thermal analyzers will top $1 million in 1979, compared with $745,000 in 1974. U.S. sales of such instruments to Australia should reach nearly $800,000 in 1979.

The United States has a slight lead over European suppliers in the sale of ***nuclear magnetic resonance (NMR) spectrometers*** to Australia. American firms (mainly Perkin-Elmer and Varian Associates) won a 55% share of the 1974 import market for such instruments. Their projected 60% share of the 1979 market would yield the United States about $630,000 in sales. Demand for NMR spectrometers has been growing recently, especially in the food industry. Planned purchases by university laboratories and the development of additional applications for NMR spectrometers should provide a further stimulus to the market.

British, Japanese, and German manufacturers are the chief competitors of American firms in sales of laboratory instruments to Australia. Purchases from these three countries represented 17%, 12%, and 8%, respectively, of 1974 imports. Several minor European suppliers together accounted for 13% of imports.

Australian end users have always respected the technical quality and durability of European laboratory instruments. Moreover, most European companies are viewed as providing excellent product support services. Historically close ties between Australia and the United Kingdom give British manufacturers an advantage in terms of "good will" as well as slightly preferential tariff treatment.

Electron microscopes, mass spectrometers, spectrophotometers, balances, and pH meters are among the types of instruments Australian laboratories commonly purchase from European or Japanese sources. The Japanese firms of Hitachi and Japan Electronic Optics Ltd., and the Dutch-owned Philips N.V. have been the main suppliers of electron microscopes. The British-owned Associated Electrical Industries, or General Electric Co. (AEI-GEC), is a market leader in mass spectrometers, followed by the Australian subsidiary of Varian Associates, whose mass spectrometers are made in Germany.

NMR spectrometers manufactured in England by Pye-Unicam and competitive models imported from Japan have a favorable position in a product subcategory which is otherwise supplied by American companies. Pye-Unicam also markets spectrophotometers that compete with those made by domestic manufacturers and those sold by U.S. firms. Australian laboratories usually buy balances from German and Swiss manufacturers and pH meters from a variety of domestic and foreign sources.

The manufacture of laboratory instruments in Australia is primarily oriented toward world markets, with emphasis on Asian and Pacific nations. There are also significant reexports of imported equipment, frequently after its modification or further assembly. Atomic absorption spectrophotometers and basic instruments such as pH meters are the main items marketed domestically.

In recent years, buoyant demand both at home and abroad has enabled Australia's laboratory instruments industry to enjoy solid growth; production jumped by an average of 19% per year between 1972 and 1975. An average growth rate of over 8.5% annually is projected for the 1975-79 period. Exports of almost $16 million in 1974 included almost $11 million from domestic production and $5 million of reexports.

Australia's improved trading relations with many Asian countries (particularly Indonesia and the Peoples Republic of China) are expected to help boost exports of Australian laboratory instruments. However, reexports of imported instruments may decline if American and other manufacturers set up production and sales subsidiaries in markets now served from Australia. Moreover, escalating wages and material costs threaten to reduce the competitiveness of Australian-produced laboratory instruments in both domestic and foreign markets. Trade sources project total 1979 exports (including reexports) at just over $21 million, reflecting a 6% annual increase over 1974's level.

Table 2.—Australia: Imports of selected laboratory instruments, 1972-1974

(in thousands of U.S. dollars)

	1972	1973	1974
Centrifuges and other filtering and purifying machinery for liquids and gases			
United States	351	521	699
United Kingdom	205	393	204
Germany	38	95	97
Sweden	50	20	...
Other countries	9	7	28
Total	653	1,036	1,028
Electron microscopes			
United States	-	280	332
Japan	6	1,045	836
United Kingdom	119	92	274
Germany	65	23	203
The Netherlands	75	381	139
Other countries	1	—	—
Total	266	1,821	1,784
Cathode ray oscilloscopes			
United States	615	1,166	2,699
United Kingdom	781	416	466
Japan	88	75	89
Germany	17	14	63
Other countries	61	60	164
Total	1,562	1,731	3,382
Gas chromatographs			
United States	312	392	633
United Kingdom	23	71	76
The Netherlands	37	47	61
Japan	30	51	31
Germany	2	10	4
Other countries	8	4	1
Total	412	575	806
Electrical/electronic strip chart measuring instruments[1]			
United States	362	436	463
Japan	270	488	582
Germany	144	163	183
United Kingdom	126	95	162
Other countries	124	109	101
Total	1,026	1,291	1,491

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[1] Figures include some instruments that are not used in laboratories.
Source: Based on data supplied by the Australian Bureau of Statistics.

Approximately 20 companies are engaged in the manufacture of laboratory instruments in Australia, but one firm—Varian Techtron Pty Ltd., a subsidiary of the U.S.-based Varian Associates—accounts for more than half of total sales. Varian-Techtron's principal product is the atomic absorption spectrophotometer, an instrument invented in Australia and originally manufactured there by Techtron prior to its merger with Varian Associates. Varian-Techtron also makes ultraviolet visible spectrophotometers, diffraction grating spectrometers, and other laboratory instruments. The company's sales are reported to have exceeded $9 million in 1974.

Other manufacturing subsidiaries of foreign makers of laboratory instruments include MSA (Aust) Pty. Ltd., a subsidiary of Mine Safety Appliance Company (United States), and Kent Instruments Pty. Ltd. (a subsidiary of G. Kent Limited of the United Kingdom).

MSA makes a limited range of air analyzers and air sampling analysis equipment for the Australian market. Kent Instruments produces modest quantities of pH meters and water analyzers, in addition to importing instruments for reexport.

Important Australian-owned manufacturers of laboratory instruments include N.L. Jones Scientific Instruments, a leading supplier of pH meters; Townson & Mercer Pty. Ltd., chlorine, sulfur, and turbidity analyzers, alkalimeters, and pH meters; J. Clements Pty. Ltd., centrifuges; and B.W.D. Electronics Pty. Ltd., cathode ray oscilloscopes, power supplies and systems, signal generators, and test instruments for the automotive industry.

Major Purchasers

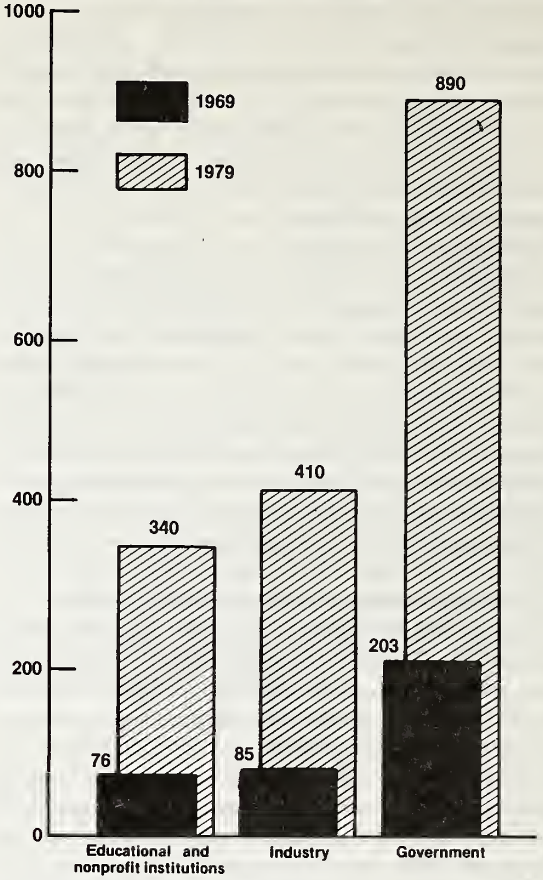
Australian expenditures for research and development (R&D) in all fields of inquiry are expected to top $1.6 billion in 1979, up from $374 million in 1969 (see figure 2). The country's spending for R&D in 1974 is estimated at $964 million; on this basis, growth between 1974 and 1979 can be projected at just under 11%.

Agriculture (especially animal health), nuclear power generation, nutrition, health care, and environmental protection are the areas likely to draw particularly large shares of R&D budgets. In support of these conclusions, observers cite the importance of agriculture, particularly livestock raising, in the Australian economy. They also note that, in light of growing world concern about energy sources, research into potential uses of Australia's substantial reserves of uranium could be expected to attract funds.

Economic development (agriculture, industry, and economic services) drew 60% of R&D funds; national security (defense, aerospace, and nuclear physics) attracted 19%; health, the environment, and community services accounted for 11%; and the general advancement of science received 10%. Of the monies spent on fields of inquiry within the natural sciences (89% of total R&D outlays), 46% went for applied research, 26% for basic research, and 28% for development.

The Government is now and will continue to be the major source of R&D funds for Australian scientists; public agencies supply about 70% of such monies. In terms of usage, federal government facilities spend 42% of total funds, while state governments spend 13%. The balance is distributed to educational and other nonprofit institutions that provide only 3% of the financial resources but utilize 21%. Industry accounts for an estimated 25% of both source and use of R&D outlays, but only 5% of Australia's industrial corporation structure plays a significant role in R&D efforts.

Figure 2. Australia: R.& D. expenditures[1], 1969 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the orginal source of the funds.

Source: 1969 statistics provided by the Australian government, Department of Science; 1979 figures based on trade source estimates.

In recent years, the number of persons studying natural sciences in Australia appears to have declined. This downward trend seems to have been most pronounced in advanced fields such as nuclear physics and aerospace. Factors that may help explain this development are the number of years of schooling required for attaining an employable level of proficiency, and a decline in salaries paid scientists and engineers relative to those paid to workers in the social sciences. As a result, facilities for studying the natural sciences at Australia's universities, colleges, and other institutions of higher learning are underutilized at present. The Government rather than the educational sector employs 70% of the country's graduate scientists and assumes responsibility for their further high-level education where necessary. Government research centers also provide on-the-job basic training for semiprofessional personnel.

Published data for 1965 show that almost 39,000 persons were employed in research and development in the natural sciences; only 11,000 of these were on the payrolls of private industry. R&D personnel working in government and at educational or other nonprofit institutions included a professional staff of over 8,000, nearly 3,000 student researchers, almost 7,000 semiprofessionals and some 10,000 classified simply as "others."

Government laboratories.—Scientific research conducted by the Australian Government in its own

Table 3.—Australia: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	1974		1979	
	Total sales	U.S. sales	Total sales	U.S. sales
Gas chromatographs	1.79	1.43	2.4	2.0
Liquid chromatographs	.90	.81	2.4	1..9
Mass spectrometers	1.10	.28	1.9	.6
NMR spectrometers	.97	.53	1.0	.6
pH meters	.75	.19	.9	.2
Densitometers	.45	.27	.5	.3
Thermal analyzers	.75	.56	1.1	.8
Automatic analyzers	1.64	1.48	2.5	2.0
Spectrophotometers	3.28	.98	4.3	1.7
Electron microscopes	1.80	.36	2.4	.6

Source: Values based on Australian trade source estimates.

facilities tends to stress areas of particular importance to the nation's economy or to national defense. Test and evaluation laboratories are maintained by the Federal Government as well as by some states. The Government spent over $33 million in 1974 to operate its laboratories, and this figure is expected to climb to over $54 million by 1979 (see table 4).

Most federally financed or conducted scientific and technical research comes under the jurisdiction of the Department of Science. In addition to its operational responsibilities, the Department formulates government policy toward participation in and financial support of R&D efforts both at home and within the international community. However, defense research carried out either in government facilities or by industry, as well as studies made in connection with the United Kingdom-Australia Joint Project, are supervised by the Department of Supply.

Australia's leading scientific research body is the Commonwealth Scientific and Industrial Research Organization (CSIRO). Administered by the Department of Science, CSIRO has 36 research divisions and about 6,700 personnel working in more than 100 laboratories and field stations throughout Australia. Scientists make up about one-third of CSIRO's staff. Funds available for CSIRO's use in 1974 totaled $134 million, of which 85% was obtained directly from the Federal Government.

Each of CSIRO's 36 divisions covers a separate field of inquiry, most efforts are concentrated on agriculture, land use, conservation, insects, and wildlife; measurement standards and chemical, physical, and engineering research of industrial interest; processing of wool and food; environmental physics, marine science, and radio astronomy; mineral exploration and processing; and computing and statistics. Many CSIRO divisions and sections work closely with universities; also, by means of grants, the organization supports university research programs in which it has special interest. CSIRO also cooperates with industry in studying such topics as food processing, construction, and mineral exploration.

The Atomic Energy Commission, an independent government agency, maintains a $45 million research center at Lucas Heights, New South Wales. More than 1,100 people are employed at this facility. In recent years, the Commission's activities have centered on technical and economic assessment of power reactors suitable for installation in nuclear power stations, with particular attention to the possibility of producing reactor fuel from domestically mined uranium.

The Analytical Laboratories, under the Department of Science, is the country's main test and evaluation facility. These laboratories provide chemical and microbiological analytical services and professional and technical advice to government departments and other public entities. Other federal agencies that maintain test and evaluation laboratories include the Departments of Customs Excise, Environment and Conservation, Health, and Primary Industry.

The CSIRO, the Department of Supply, and the Atomic Energy Commission are the largest government sector buyers of laboratory instruments. Their purchases and those of other public agencies are estimated to represent one-third of the market.

Several projects that would assure steady growth in government demand for laboratory instruments are to be undertaken between 1975 and 1979. The Australian National Animal Health Laboratory, to be administered by CSIRO's Division of Animal Health, has been approved for construction at Geelong in Victoria State. This $88 million facility is designed primarily to prepare for livestock diseases not presently endemic in Australia might be introduced there accidentally, endangering the country's extensive herds. Scientists at the new laboratory will study diagnostic techniqúes, make and test vaccines, and research viral infections of livestock.

The CSIRO is building a $20 million National Measurement Laboratory in Sydney. The primary activity of the facility, scheduled for completion in 1977, will be to measure physical quantities. The estimated cost of instruments required for this new laboratory is $660,000. Plans to build an additional laboratory at the CSIRO Division of Fisheries and Oceanography center in Cronulla, New South Wales, are to be implemented late in 1975. The new facility will be used to study the dynamics of Australia's estuarine ecosystems. Approximately $66,000 worth of new laboratory instruments will be required.

Scientists at Australia's larger government laboratories use nearly all of the analytical methods in their research, with the possible exceptions of X-ray techniques, saccharimetry, and magnetic susceptibility. Moreover, there is a definite trend toward the application of electronic data processing technology in scientific studies. Most government sector users prefer to interface minicomputers —typically a model such as the PDP-15—with existing instruments. Researchers usually buy these minicomputers without software and adapt them to their specific needs.

Types of laboratory instruments likely to be purchased during the 1975-79 period for use in Australian government laboratories include electron microscopes, mass spectrometers, liquid scintillation counters, automatic analyzers, and atomic absorption spectrophotometers. CSIRO's Food Research Laboratory has already budgeted approximately $215,000 for the purchase in 1978 of an electron microscope and an NMR spectrometer.

Educational and nonprofit research laboratories.—Most of the research carried out at laboratories in this sector is performed in university facilities. Private nonprofit organizations employ only 260 of the nearly 6,500 professional and semiprofessional staff reported to be working in educational or nonprofit research laboratories.

Studies done at scientific laboratories in Australian institutions of higher learning have usually stressed projects directly related to the teaching of the physical sciences. Now, however, an influx of federal funds intended to upgrade the nation's college-level education is enabling graduate students to do more extensive basic and applied research in areas of further benefit to society.

The most important educational or nonprofit research laboratories are those located at Australia's 20 major universities. Each of these institutions has facilities for the study of the full range of physical sciences. Some of them may spend as much as $75,000 annually on laboratory instruments, including costly units for sophisticated research and analysis. Among these are the biochemistry and chemistry laboratories at the University of Sydney, the chemical engineering laboratory at the University of New South Wales, the chemistry laboratories at Macquarie University and the University of Melbourne, and the biological sciences laboratory and Institute of Advanced Studies at the Australian National University.

Plans for the construction of new laboratory facilities at Australian educational institutions during the 1975-79 period include the expansion of the chemistry laboratory at Macquarie University, where $40,000 has been earmarked for the purchase of additional instruments, and the establishment of a chemistry laboratory at the Institute of Technology in Meadowbank, New South Wales. In addition, the University of Sydney's School of Biochemistry has budgeted more than $50,000 for laboratory instruments needed to begin a federally financed program of research into the biological sources of energy production. Additional funds are being sought for a gas chromatograph/mass spectrometer system for use on the same project.

Educational institutions in Australia have been quick to adopt electronic data processing (EDP) techniques for laboratory use. A number of minicomputers have been installed, typically interfaced with existing instruments such as mass spectrometers and gas chromatographs. It is expected that university and other nonprofit laboratories will boost their investment in EDP equipment because of the success they are having with the apparatus already acquired. Other laboratory instruments expected to be purchased in significant volume by educational and other nonprofit research institutions during the 1975-79 period include electron NMR spectrometers, spectrophotometers, and liquid chromatographs.

Laboratories in the chemical industry.—The chemical industry is Australia's largest industrial market for laboratory instruments. The sector's purchases of laboratory instruments are placed at $2 million in 1974 and projected at $2.7 million for 1979.

The past 15 years have seen the chemical industry emerge as a dynamic force in the Australian economy and an important contributor to export earnings. Latest published figures show that during the decade that ended in 1971, chemicals sales rose by a yearly average of 12%, while the industry's capital investment rose at the rate of 10% annually. Growth since 1971 appears to have been similarly impressive. Projections suggest that sales may approach $4.5 billion in 1979, while capital investment may exceed $220 million. The figure for investment does not include spending for the proposed Redcliffe petrochemical complex tentatively scheduled to be built in South Australia beginning in 1978.

Not all the subsectors of Australia's diversified chemicals industry are experiencing the same degree of prosperity. Demand for basic chemicals has fallen off considerably. Manufacturers of agricultural chemicals and fertilizers, however, anticipate at least 5 years of solid sales growth, mainly because of strong export demand for their products. The outlook for pharmaceuticals is also favorable.

A 1969 government survey showed more than 2,400 persons employed in the chemical industry's 450 laboratories. Small facilities spending less than $12,000 annually for instruments represent about half the total number of laboratories. Fewer than 10% of the laboratories in the chemicals industry have instrument budgets of $30,000 or more per year. Many major chemicals laboratories are operated by multinational firms such as Imperial Chemical Industries (ICI), Roche Products, Merck, Sharpe & Dohme, Shell Chemical, and Union Carbide.

Several chemical industry projects that would entail substantial purchases of laboratory instruments are slated to be undertaken during the next few years. The largest is the Redcliffe petrochemicals complex to be completed in 1979. This facility—to be built jointly by ICI, Alcoa, Mitsubishi, and C.S.R. Chemicals—will include a $450 million plant to manufacture caustic soda, chlorine, and (eventually) ethylene dichloride. A large laboratory designed for both R&D and test and evaluation work will be part of this plant.

ICI plans to spend $65,000 by 1976 for laboratory instruments in the course of expanding its organic chemicals laboratory to provide space for additional development programs and quality control work. Up-

Table 4.—Australia: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	420	$33.20	$54.5	$12.96	$18.6
Educational and nonprofit institutions	350	23.02	41.6	9.69	15.2
Independent commercial laboratories	100	2.45	3.7	1.00	1.3
Medical organizations	220	13.98	25.6	5.96	9.0
Industry:					
Oil and gas extraction	20	1.42	2.7	.45	.9
Food products	300	3.63	5.9	1.49	2.1
Chemicals	450	4.84	7.5	2.01	2.6
Petroleum	50	2.41	3.9	1.04	1.5
Rubber and plastic products	40	.70	1.4	.26	.4
Stone, clay, and glass	180	1.55	2.8	.67	1.0
Primary metals	250	3.46	5.7	1.31	2.1
Fabricated metal products	80	1.72	3.1	.60	1.1
Transportation	100	2.01	2.9	.82	1.0
Other	200	1.90	2.7	.74	.9
Total	2,760	$96.29	$164.0	$39.03	$57.1

Source: Values based on Australian trade source estimates.

john Pty. Ltd. will double the size of its quality control laboratory in 1976, budgeting $33,000 for new instruments.

The principal methods of analysis utilized in Australia's chemicals industry laboratories are chromatography, colorimetry, electrophoresis, and polarimetry. Electrometric and spectrometric methods are also employed. Neither saccharimetry nor electron paramagnetic resonance techniques are widely used.

The chemicals industry has begun to apply EDP techniques to chemical analysis. The major research laboratories have already acquired EDP equipment, and most other laboratories plan to buy such apparatus in the near future. Minicomputers are being interfaced with instruments already in use, since the purchase of complete systems is regarded as too costly.

Types of laboratory instruments which are of particular interest to chemicals manufacturers for use in their Australian plants include electron probe analyzers, automatic analyzers, spectrophotometers, and liquid chromatographs.

Laboratories in the food processing industry.—Rising prosperity has spurred Australian consumer spending on processed food, particularly meats, beverages, and confectionery products. Total sales for the industry are estimated at nearly $8 billion for 1974, compared with $6 billion in 1972. Sales of food products are expected to climb by an average of 8% per year through 1979. Meeting this greater demand from both domestic and export customers has entailed substantial increases in the industry's level of capital expenditures. Investment is expected to exceed $400 million in 1979, compared with over $200 million in 1972.

An upsurge in public concern about the quality of the foods offered for sale in Australia has accompanied the rapid rise in consumption. The industry has been accused of failure to perform sufficient analytical tests to determine the nutritional value of its products and of laxity in the entire area of quality control. The Government has responded by formulating more stringent regulations covering plant sanitation, standards of wholesomeness, and product labeling. Special attention is being paid to conditions in the dairy and meat products sectors. Most companies will eventually have to upgrade their laboratory facilities and hire additional technical staff eventually.

There are about 300 laboratories in the Australian food processing industry. Total employment in such facilities exceeds 900 persons. The industry's 1974 outlays for laboratory instruments are estimated at $1.5 million; expenditures for such purposes could total over $2 million in 1979. Small facilities, budgeting approximately $7,500 annually for laboratory instruments and used only for quality control and test and evaluation, account for roughly 75% of the total number of laboratories in the food industry. An additional 15% might be classified as of medium size, with instrumentation outlays averaging up to $22,000 per year. The 30 largest laboratories together account for almost half the food processing industry's total purchases of laboratory instruments.

A list of Australia's leading food processing laboratories includes Edible Oil Industries (a division of Unilever, specializing in analysis, test, and evaluation of fats and oils); Mauri Brothers and Thompson Research Laboratories (product research and development, process development, and biological testing for all sectors of the food industry); C.S.R. Research Laboratories (research, test, and evaluation of sugar, alcohol, and other products of the C.S.R. group of companies); Kraft Foods Research and Development Laboratory (specializing in protein and flavor chemistry); and Reckitt & Colman Foods (research and quality control for a variety of foods).

All major food industry laboratories rely on chromatography, colorimetry, and spectrometry for the bulk of their analysis work. Particle size analysis can also be important, and NMR techniques are employed in performing research on moisture content. Mass spectrometry is used in the largest facilities, but electron microscopy is not yet widely used. The relatively few food processors that have adapted EDP techniques to laboratory use have interfaced a minicomputer, such as the NOVA, with a Varian atomic absorption spectrophotometer or with a series of gas chromatographs.

Types of laboratory instruments expected to be purchased for use in Australian food processing laboratories during the 1975-79 period include liquid chromatographs, automatic analyzers, spectrophotometers, and mass spectrometers.

Trade and Technical Requirements

Most types of laboratory instruments imported into Australia from the United States are subject to a duty of 6%; however, tariffs on certain items, notably pH meters and electrical/electronic measuring, analyzing, or automatically controlled instruments, range as high as 34%. Somewhat lower rates apply to goods imported from British Commonwealth nations. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The characteristics of Australia's electrical supply are 240 volts, 50 hertz, 3-phase. Laboratory instruments must conform to universal electric safety standards and cable color-coding systems. Although the imperial system of weights and measures is still acceptable in Australia, the metric system is widely used and will be used exclusively by 1980. Further information on Australian technical standards is available from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Australia is available on a continuing basis from:

Country Marketing Manager-Australia
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

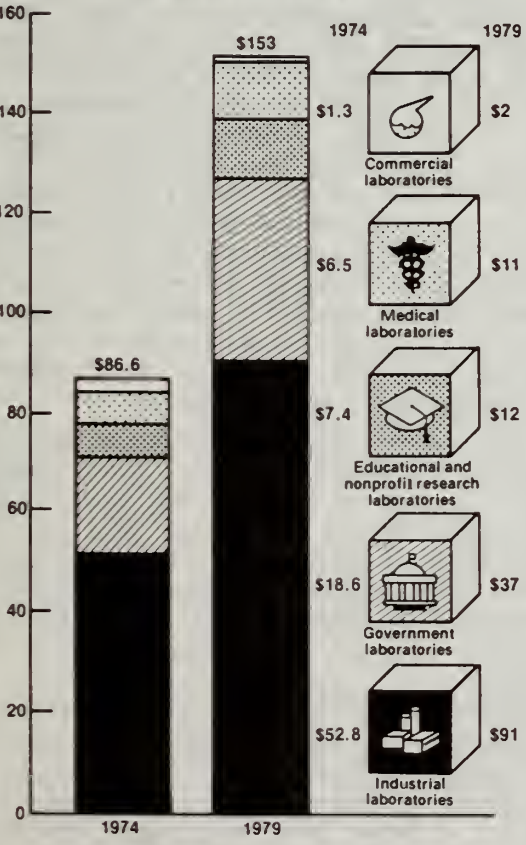
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Australia," DIB 75-05-512, February 1975.

Brazil

The Brazilian market for laboratory instruments has strong sales potential in view of the country's rapid industrial development. Imports are expected to fill about 95% of total requirements as purchases rise to a predicted $153 million[1] in 1979 under the impetus of ambitious government and industry programs to extend domestic technological capabilities (see figure 1). Based on a 1974 value of nearly $87 million, the average annual growth rate projected for the 1974-79 period is 12%—the same rate anticipated for aggregate industrial production in the official Second National Development Plan.

Figure 1. Brazil: The market for laboratory insturments 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report. Values based on Brazilian trade source estimates

Total laboratory instrument sales, which amounted to close to $44 million in 1972, had nearly doubled by 1974, reflecting the establishment of a number of new research institutes as well as extensive modernization in existing facilities. In industry, new demand for quality control emerged as manufacturers adopted sophisticated processing technology. In Government, the high priority assigned to economic development resulted in heavy expenditures for basic and applied research in laboratories. In education and medicine, improved instrumentation, including some automated equipment for clinical analysis, was widely purchased. Since 1974 the market has continued to expand, but more slowly, in response to import restrictions prompted by the country's worsening balance of trade. Estimated sales for 1975 were $97 million, up 12% from the preceding year (see table 1).

The planned construction of several large research centers, in addition to continuing program expansion, should boost total laboratory expenditures from $892 million in 1974 to $1.6 billion in 1979. Instrument purchases represent about 10% of expenditures.

Government laboratories, which carry on most of the basic and applied research in the country in behalf of industry, are likely to expand more rapidly than those of the other end users. Government programs to speed the development of key industrial sectors, including chemicals, petrochemicals, electric energy, and metals, indicate that the public sector's laboratory expenditures and instrument purchases will rise at an average annual rate of nearly 15% over the 1974-79 period. The total

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = CR$ 5.93 (1972); CR$ 6.13 (1973); and CR$ 6.79 (1974 and subsequent years).

Table 1.—Brazil: Size of market for laboratory instruments, 1972, 1974, and estimated 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	2.1	4.2	5
Imports	42.3	83.4	93
Exports	.7	1.0	1
Market size[1]	43.7	86.6	97

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[1] Market size equals production plus imports minus exports.
Source: Values based on Brazilian trade source estimates.

projected expenditures in the latter year are $370 million, including $37 million for instruments.

Sizable increases are also forecast for industrial and medical laboratories. The former sector is the largest consumer of laboratory instruments in the country. Continuing expansion of quality control efforts and product development activities are expected to bring total expenditures to about $942 million in 1979, with instrument purchases amounting to about $91 million. Over the next few years, a growing interest in public health should enable medical laboratories to enlarge their programs, raising total expenditures to $110 million in 1979 and instrument purchases to about $11 million.

Competitive Environment

With domestic production capable of supplying only about 5% of the total market, Brazil imports large quantities of conventional laboratory instruments as well as advanced and high-precision equipment. This circumstance, along with the overall growth potential of the market, has led European and Japanese suppliers to step up their sales efforts in recent years, and the latter have been particularly successful in expanding business. However, thanks to the unrivaled technical reputation of U.S.-made instruments and the strong presence of American business in Brazil, the United States remains the country's principal supplier of laboratory equipment by a large margin (see table 2).

Trade sources believe that the United States should be able to maintain a 41% share of the import market and nearly 40% of the total market. The level of imports from the United States would thus rise from an estimated $38 million in 1975 to almost $61 million in 1979. This projection places the U.S. import share about midway between the 1972 high of nearly 46% (purchases worth $19 million) and the 1974 low of 37% (or $31 million).

U.S. industry sells a wide range of laboratory instruments in Brazil. Important American manufacturers and their leading products include: Fisher Scientific Co., a principal supplier of pH meters and thermal analyzers; Varian Associates, liquid chromatographs and nuclear magnetic resonance (NMR) spectrometers; Perkin-Elmer, automatic analyzers and ultraviolet (UV) and visible light spectrophotometers; and Bausch & Lomb, electron and other microscopes.

Packard Instruments offers chromatographs, viscometers, and osmometers; Sargent-Welch Co. supplies polarimeters and colorimeters; and Leco Corporation excels in sales of instruments for the analysis of carbon, sulfur, and gas in metallic and nonmetallic compounds. In addition, Coulter Electronics and Technicon virtually dominate the market for automatic clinical analyzers; duPont's Instrument Products Division sells thermal analyzers, laboratory centrifuges, and other instruments; and Beckman Instruments provides a variety of products.

A factor which frequently assists American sales efforts is the prevalent practice of buying complete instrument systems when new manufacturing processes are instituted. Also, U.S.-affiliated firms tend to select laboratory equipment according to home-office specifications.

Germany and Japan are the chief third-country suppliers of laboratory instruments to Brazil. German manufacturers, such as Georg Reicherter, Mohr and Federhaff and Losenhausen (MFL), Sartorius Werke, Rudolph Brand, and August Sauter KG, accounted for a relatively stable 20% share of imports between 1972 and 1974. Typical products were precision balances and instruments to test the mechanical properties of metals.

Japanese sales appreciated from $3 million in 1972 to an estimated $12 million in 1974, representing an increase in the country's share of imports from 7% to 14% over the period. Low-cost, conventional items were the predominant goods traded by the Japanese; however, sophisticated instruments were being introduced. Among the firms doing a sizable volume of business were Nikon-Nippon Kogaku, KK (marketing optical microscopes and stereoscopes); Shimadzu Seizakusho Ltd. (spectrophotometers and gas chromatographs); Hitachi Ltd. (electron microscopes); Olympus Optical Co., Ltd. (electronic and non-electronic microscopes); and Atago Optical Works Co. Ltd. (refractometers and polarimeters).

Other countries with significant sales are the United Kingdom, Switzerland, and Italy. British manufacturers active in the market include Rank Precision Instruments and Pye Unicam Ltd. Rank sells mass spectrometers; Pye-Unicam, a range of instruments. Mettler Instruments AG and Metrohn (Switzerland) are important in the market for balances and pH meters; Cellomatic (Italy) is the leading supplier of densitometers.

Domestic production, which offers little competition to imports, consists mostly of standard, low-precision items suitable chiefly for school or hospital use. As yet, the industry includes no manufacturing subsidiaries or licensees of foreign firms and produces few modern research tools. Little expansion of capacity is anticipated in view of the end users' regard for the superior quality of imported products, the small size of most domestic firms, and the high costs of production. Despite strong tariff protection, Brazilian instruments are often more expensive than their imported counterparts. Domestic sales, which amounted to $4.2 million in 1974, are not expected to exceed $7.3 million in 1979.

Typical products from the country's 25 instrument manufacturing firms are microscopes, thermometers, and sterilization equipment. Seven of the firms account for about 80% of sales. These include four enterprises whose products compete to some extent against imports, namely Instrumentos Cientificos CG, Ltda. (gas chromatographs), Procyon Instrumentacao Cientifica para Laboratorio Ltda. (pH meters), Marte Balancas e Aperelhos de Precisao Ltda. (precision balances), and Fanem Ltda. Fabrica de Aparelhos Nacionais de Eletromedicina (centrifuges).

Selected instrument market.—A market research study recently conducted in Brazil for the Office of International Marketing, Bureau of International Commerce, has identified some of the principal trends affecting sales for 14 selected instruments.

Total sales of ***gas chromatographs*** should rise at a rapid average annual rate of 20% over the 1974-79 period to a total of $4.3 million in the latter year (see table 3) as Brazilian scientists learn to widen the range of applications for these instruments. Domestically produced electron capture and flame ionization chromatographs will probably supply about 70% of total requirements in the market by 1979. A widening use of thermal conductivity and other types of chromatographs, however, should continue to provide good import opportunities. Varian and Shimadzu have been the leading foreign suppliers.

There should also be strong growth in the totally import-supplied market for ***liquid chromatographs and NMR and mass spectrometers*** although sales of these three instruments and ***X-ray analyzers*** will probably remain confined to the largest and most sophisticated laboratories in the country. Scientists at leading research institutes are encouraging others to use high-performance liquid chromatography (HPLC), chemical ionization mass spectrometry, NMR, and other advanced methods of analysis. Liquid chromatographs and NMR spectrometers have been furnished principally by Varian, mass spectrometers by Rank, and X-ray analyzers by Rigaku (Japan).

pH meter sales are predicted to rise to about $1.1 million in 1979, with imports continuing to account for about 75% of the market. All digital readout models are imported, predominantly from Fisher and Metrohn. Portable and expanded-scale models are available from domestic producers, although the manufacturer, Procyon, has encountered difficulty in obtaining electrodes and other components.

Among the larger laboratories, a good market for ***densitometers*** and ***thermal analyzers*** (especially those capable of measuring high polymer thermal characteristics) is developing. Most of the former come from Cellomatic (Italy), and the latter from Fisher or duPont. Demand for automatic analyzers is also increasing. Toa Medical Electronics Co. Ltd. of Japan has begun to compete with U.S. suppliers for sales of automatic diluters and electronic cell counters.

Table 2.—Brazil: Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Centrifuges for laboratory use			
United States	489	637	344
Germany	42	68	146
Japan	9	19	25
United Kingdom	20	62	23
Other	83	20	51
Total	643	806	589
Microscopes and diffraction apparatus, electron and proton			
United States	96	183	392
Japan	242	118	102
Germany	139	104	80
Other	101	223	272
Total	578	628	846
Mechanical appliances for testing physical properties of industrial materials			
United States	1,067	1,873	947
Germany	879	894	766
Japan	146	687	250
United Kingdom	48	253	142
Other	831	610	545
Total	2,971	4,317	2,650
Instruments and apparatus for physical or chemical analysis, nonelectrical and nonelectronic			
United States	2,480	6,027	5,789
Germany	701	1,301	1,080
United Kingdom	261	481	381
Japan	103	1,055	145
Other	945	1,165	1,971
Total	4,490	10,029	9,366
Electrical and electronic measuring, analyzing, or automatic-controlling instruments[2]			
United States	15,462	15,314	12,342
Germany	5,121	7,534	6,220
Japan	1,839	4,268	2,013
United Kingdom	198	545	332
Other	7,862	7,995	7,990
Total	30,482	35,656	28,897

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[1] January to August only.

[2] About 40% of these instruments are used for process control.

Source: Data based on statistics provided by the Government of Brazil, Bureau of International Trade.

Electron microscopes, previously considered too costly for extensive use, are also gaining in acceptance. Stimulated by the expansion and upgrading of laboratory activity in Brazil, sales are projected to increase at about 21% annually between 1974 and 1979 to over $3 million in the latter year. Bausch & Lomb and Hitachi are the two leading suppliers.

Total sales of ***balances*** are expected to increase from over $2.1 million to nearly $3.7 million between 1974 and 1979. Although there is some domestic production, imports are likely to continue to fill about 85% of requirements. The major source of balances in the market is Mettler, whose electronic precision models PT 1200 and PS 1200 and analytical models H 31, H 33, H 35,

Table 3.—Brazil: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatographs	1,713	738	323	652	4,262	889	390	2,983
pH meters	600	186	264	150	1,057	328	465	264
Electron microscopes	1,142	529	613	—	3,036	1,406	1,630	—
Balances	2,112	240	1,560	312	3,669	422	2,749	498
Compound optical microscopes	2,522	71	2,451	—	4,444	125	4,319	—
Thermometers	7,322	—	7,322	—	12,904	—	12,904	—
Centrifuges	1,177	516	367	294	2,074	604	436	1,034

Source: Values based on Brazilian trade source estimates.

and H 51 lead in popularity. The large size of the market, however, indicates opportunities for sales by other manufacturers.

Compound microscopes and maximum and minimum clinical thermometers are the most extensively purchased instruments under survey, and imports supply the entire market. Sales of microscopes should reach about $4.4 million in 1979, and of thermometers, nearly $13 million. The former have been furnished largely by German and Japanese manufacturers, and the latter almost entirely by Japanese firms.

With a predicted sales level of $2.1 million in 1979, ***laboratory centrifuges*** should afford continuing sales opportunities to U.S. manufacturers. DuPont and the International Equipment Company have been the two leading suppliers in the past. However, the domestic share of the market is likely to grow from about 25% in 1974 to 50% in 1979, in view of plans by the Brazilian manufacturer, Fanem, to expand its capacity for the production of horizontal and microhematocrit centrifuges. Fanem also hopes to extend its activities to include some export business.

Major Purchasers

The Brazilian Government plans substantial increases in research and development (R&D), especially with respect to nuclear energy, electrical energy, petroleum and petrochemicals, metallurgy, and aerospace. Work will be carried on at research centers operated by government organizations, universities and other nonprofit institutions, and industry. Total R&D spending is projected to rise at an average annual rate of 25% from $500 million in 1974 to $1.5 billion in 1979.

The influence of the Government on R&D cannot be overstated. In addition to supplying about 70% of funds, it operates some of the largest research centers in the country directly and supervises or coordinates many of the programs carried on by other organizations. Most of the leading universities and medical centers in Brazil are public facilities, and there is a strong government presence in industrial research as well. Several of the largest industries in the country (for example, petroleum and electric utilities) are State owned, and they in turn often participate in the ownership of related enterprises.

Major R&D objectives are set forth in an official "Basic Plan for Technological and Scientific Development." Specific activities are coordinated through a number of ministries and special commissions. Funds can be channeled to the private sector through the National Economic Development Bank (BNDE) and a fund for technical development (FINEP). As a consequence of this close relationship, industrial and nonprofit research institutions share almost equally with government centers in the spending of R&D funds (see figure 2). In general, laboratory expenditures account for about 20% of the available monies, although the proportion is somewhat higher in government laboratories because they tend to use more expensive and sophisticated instruments.

The recent emphasis on scientific development in Brazil is bringing about a shift in the educational system to produce a higher proportion of scientists and technicians. Most of the scientists now working in the country received their training abroad, principally in the United States, Germany, or the United Kingdom.

According to the 1970 census, more than 400,000 persons were in scientific or technical occupations; however, relatively few were regularly engaged in laboratory activity. The disciplines with the highest proportions of workers were medical or dental laboratory technicians (38,600), agronomists (6,800), chemists (4,500), pharmacists (3,900), geologists (1,000), biologists (900), and physicists (200). Most of the remainder were engineering (103,000), or medical personnel (233,000).

Government laboratories.— Government institutes are directly responsible for research in nuclear technology, aerospace, oceanography, petroleum and petrochemicals, electrical energy, and minerals resources. Programs are being expanded in each of these areas and several large new facilities are planned

The agency coordinating the nuclear program is the National Commission of Nuclear Energy. Projects are conducted primarily by laboratories of the state-owned Brazilian Company of Nuclear Technology and those of five other public organizations: the Institute for Research in Radioactivity, the Institute for Nuclear Engineering of Guanabara, the Institute for Atomic Engineering of Sao Paulo, the Center for Agricultural Nuclear Studies (attached to the Luiz de Queiroz Agricultural School in Piracicaba, Sao Paulo), and the Company for Research in Mineral Resources (CPRM). Principal areas of inquiry are small reactor technology; problems in the construction of rapid reactors; technology for the manufacture of ammonium diuranate and uranium dioxide; and the application of isotopes in medicine, engineering, industry, and radioisotopes in agriculture.

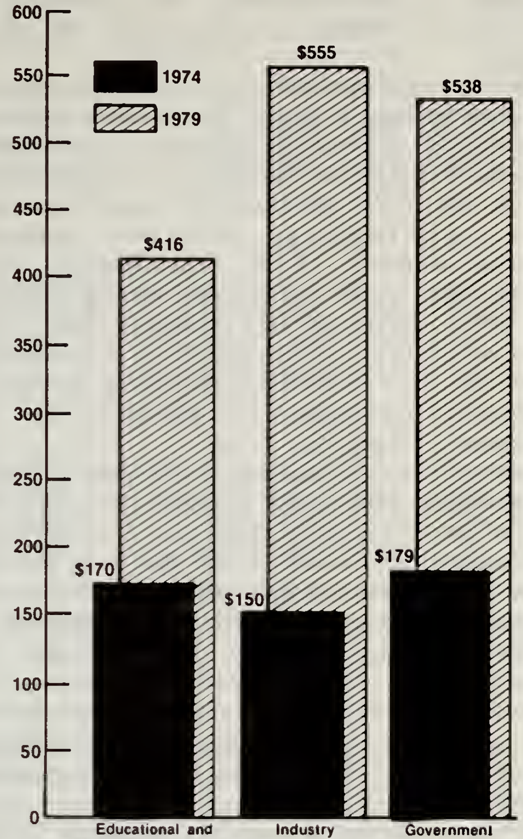
Aerospace programs are carried on by each of the three Defense Ministries and the Communications Ministry, which is exploring the feasibility of constructing a communications satellite. The Air Ministry is experimenting with aerological probes; the adaptation of aerospace technology to mineralogy, hydrology, oceanography, and botany; radioastronomy; meteorology; and the application of laser techniques to geophysical problems. The Navy is concerned primarily with navigation techniques by satellite and remote control; and the Army, with missile technology, solid fuels, and a missile test system.

The Navy also sponsors oceanographic research and plans to construct three large centers for physical, chemical, and biological studies of the marine environment. A major objective is the development of technology for the extraction of minerals from beneath the sea.

Petroleum research is coordinated and conducted largely by a research institute, CENPES, operated by the State-owned petroleum company, Petrobras. CENPES has the largest complex of laboratories in the country, and their facilities are among the best equipped. CENPES strongly influences the laboratory programs of downstream petroleum and petrochemical companies. Current programs range from inquiry into geological and geochemical methods for the evaluation of reserves to product development and testing. Included are studies of refining methods, chemical analytic methods, corrosion prevention, polymers, petrochemicals, and methodologies for extraction of oil from shale.

Research in mineral resources consists of geological structure studies, mapping, geochemical prospecting, and radiometric investigations. The government-controlled company, CPRM, conducts or finances most of the important programs in this field. CPRM is expanding its technical center at Rio de Janeiro and constructing a new one at the Federal University of Bahia. Both projects offer excellent potential for sales of advanced instruments.

Figure 2. Brazil: R&D expenditures,[1] 1974 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the source of funds.

Source: Data based on the Brazilian National Development Plan II, 1974.

Also under construction is a large technical center for electrical research. This facility, modeled after CENPES, will perform research and testing for the government-owned electric utility company, Eletrobras, and coordinate programs of other facilities concerned with electrical research. Like the new minerals research institute, it will probably be very well equipped with sophisticated instruments. Planned areas of study include hydrometry and the integration of electrical systems.

Government activities in the field of testing and evaluation receive less emphasis than the basic and applied research areas. Testing and evaluation responsibilities are distributed among a number of agencies and institutes, many of which lack the resources to carry out assigned tasks. For example, the Associacao Brazileira de Normas Technicas, charged with the establishment of norms and specifications for industrial products, has as yet set forth only 650 regulations. Moreover, testing is usually performed at the request and expense of the producer by independent laboratories. Food, drugs, and water may be tested by the Instituto Adolfo Lutz, an agency of the State of Sao

Paulo or by the Federal Ministry of Agriculture's Food Technology Institute (Instituto de Tecnologia Alimentar). Communications equipment may be tested by the Ministry of Communications; and pharmaceutical products, by SNFMF, an agency of the Ministry of Health.

Government laboratories include the largest and best equipped facilities in Brazil. The research centers use sophisticated instruments extensively and actively promote their adoption elsewhere. Among the methods in use are NMR spectrometry, atomic absorption spectrophotometry, electron emission spectrophotometry, X-ray diffractometry, X-ray fluorescence, nuclear electroscopy, mass spectrometry, and HPLC. Electronic data processing (EDP) equipment is little used presently, but there is a growing demand for such instruments. Complete systems are preferred to minicomputers for interfacing with other laboratory instruments.

Instruments corresponding to the above mentioned methodologies offer highly favorable sales potential in view of planned program expansions. A range of more conventional instruments should also be in heavy demand. All laboratories operated by the Government (including many university and hospital laboratories) procure their equipment through public tender.

Educational and nonprofit laboratories.—In Brazil, such facilities often conduct product development, quality control, and testing activities for industry and government organizations and also perform an academic research function. Total laboratory expenditures are projected to reach $117 million in 1979, in contrast to slightly over $74 million in 1974 (see table 4). Laboratory instrument purchases should continue to account for 10% of spending.

Included in this sector are two of the country's leading laboratories: the Institute for Technological Research (IPT) at the University of Sao Paulo and the Instituto Adolfo Lutz, attached to the Public Health Secretariat of the State of Sao Paulo. IPT operates the foremost laboratory for chemical research in Brazil. Among the equipment items recently purchased are an atomic absorption spectrophotometer, infrared (IR) spectrophotometer, and molecular weight apparatus from Perkin-Elmer and Hitachi; other types of spectrophotometers, gas and liquid chromatographs, thermal analyzers, electron spin resonance apparatus, and additional instruments have been provided almost exclusively by Japanese suppliers. The Instituto Adolfo Lutz is prominent nationally in virological, bacteriological, and parasitological analysis; and food, drug, and water testing.

The principal research centers commonly use the following methods: emission spectrographic analysis (for ferrous and nonferrous metals, plant ash, and inorganic elements in oils); liquid chromatographic analysis (synthetic resins, dyes, paints, foods, amino acids, acetic acids, proteins, serum, and urine); spectropolarimetric analysis (proteins, amino acids, steroids, alkaloids, nucleic acids, viruses, food additives, and carbohydrates); polarimetric analysis (sugar, enzymes, steroids, and alkaloids); gas chromatographic analysis (styrene, ethylene, glycol, barbiturates, sugars, fatty acids, pesticides, and food additives); spectrophotometry (industrial and agricultural products and clinical analysis); mass spectrometry (gasoline, naphtha, synthetic resins, fibers, food additives, medical and pharmaceutical products, agricultural chemicals, and pollution levels); and electron microscopy.

Medical laboratories.—The growing emphasis on health care in Brazil resulted in medical laboratory expenditures of almost $65 million in 1974, affording about $6.5 million for instrument purchases. Public sector institutions, which provide about 85% of health care services, also maintain some of of the country's largest medical laboratories. By far the largest purchaser of instruments in the sector is the National Social Security Hospital system (INPS). With laboratories throughout Brazil, INPS is probably the second-largest individual consumer (after CENPES) of laboratory instruments in the country. In addition, extensive laboratory facilities are maintained by five other public health centers, four private hospitals, and about five major private laboratories for clinical analysis. Colorimetry, flame photometry, fluorometry, photometric enzyme analysis, and particle size analysis are increasingly used. In the larger laboratories, there is a growing demand for completely automated systems.

Laboratories in the transportation industry.—Brazil's 147 manufacturers of motor vehicles, ships, aircraft, farm machinery, and railroad equipment must increasingly upgrade quality control and product testing activities, as they improve and expand their product lines and conform to new vehicle safety laws. The transportation industry's laboratory expenditures, which are higher than those of any other industrial sector, are projected to increase from $119 million in 1974 to $183 million in 1979. Instrument purchases in the latter year are predicted to total $12 million. Most of the firms in the industry maintain at least one laboratory.

In 1973, Brazilian firms produced approximately 456,000 passenger cars; 65,000 trucks; 6,000 buses; and 196,000 station wagons; also, 3,200 railroad tank and freight cars; 73,400 tractors; 83 aircraft; and 3 oil tankers—weight 79,200 metric tons (MT), 12 freighters (almost 125,000 MT), and 2 bulk carriers (49,400 MT). Foreign-owned subsidiaries, including Volkswagen, Ford, Mercedes Benz, General Motors, and Chrysler Motors, are heavily represented.

For the most part, transportation industry laboratories analyze materials, control the preparation of sintered materials, assist in the quality control of machine tools, test the physical and mechanical properties of parts and accessories, and perform chemical and metallographical analyses. The methods employed include densitometry; optical microscopy; electron

Table 4.—Brazil: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	NA	$185.8	$370	$18.6	$37
Educational and nonprofit institutions	NA	74.1	117	7.4	12
Independent commercial laboratories	NA	13.4	21	1.3	2
Medical organizations	NA	64.9	110	6.5	11
Industry:					
Oil and gas extraction	11	34.4	54	3.4	5
Food products	514	5.4	10	.5	1
Chemicals	231	49.4	84	4.9	8
Petroleum	24	6.0	10	.6	1
Rubber and plastic products	87	8.4	15	1.7	3
Stone, clay, and glass	137	4.9	9	1.0	2
Primary metals	142	47.9	77	5.0	8
Fabricated metal products	239	23.2	38	2.3	4
Transportation	147	119.0	183	7.9	12
Other	804	255.5	462	25.5	47
Total		$892.3	$1,560	$86.6	$153

Source: Values based on Brazilian trade source estimates.

microscopy; pH methods; thermal analysis, with colorimeters and thermometers; viscosimetry; spectrometry; and strength, resistance, traction, and compression tests. Minicomputers are not yet used in transportation industry laboratories, although interest in them is developing.

The following instruments are expected to be in especially heavy demand over the next few years:

- Gas analyzers
- Pyrometers
- X-ray analyzers
- Spectrometers
- Balances
- Colorimeters
- Microscopes
- Strength measurement apparatus

Laboratories in the chemical and petrochemical industry.—The Brazilian chemicals and petrochemicals industry consists of 230 companies with net assets of $1.7 billion in 1973. Most firms operate laboratories for quality control and materials testing. In aggregate, the industry spent $49.4 million for laboratories in 1974. Generally, most product development and other applied research activities are carried on by CENPES or by foreign principals. The expansion of production in the sector should boost laboratory expenditures to $84 million in 1979, allowing $8 million for instrument purchases.

The primary producer of petrochemical products is Petroquimica, a subsidiary of the state-owned petroleum company, Petrobras. Petroquimica has the capacity to produce approximately 930,000 MT annually of petrochemical products, consisting principally of ethylene, propylene, and benzine, which it furnishes to a complex of downstream industries. In addition to national companies, there are a number of foreign-controlled firms in the industry. Among the latter are Union Carbide do Brasil Alba, S.A., a U.S. subsidiary; Rhodia Ind. Quimicas e Texteis S.A., a French concern; and the Dutch-owned Industrias Quimicas Electro Cloro S.A. Additional U.S. firms represented are Bayer, Dow Chemical, du Pont, Squibb, Pfizer, and Merck.

Laboratories operated by such companies employ gas chromatography for the analysis of styrene, ethylene, glycol, barbiturates and other drugs, and pesticides. Optical microscopes and pH meters are also widely used. As yet, demand for minicomputers or other electronic processing equipment has not developed.

According to trade sources, the continued expansion of production and the upgrading of laboratory technology should provide favorable sales opportunities for the following instruments:

- Liquid chromatographs
- Gas chromatographs
- Flame photometers
- IR spectrophotometers
- UV and visible-light spectrophotometers
- Electron microscopes
- Thermometers
- Particle size analyzers

Laboratories in the rubber and plastic products industry.—The laboratory expenditures of the rubber and plastic products industry are expected to increase from $8.4 million in 1974 to $15 million in 1979, and instrument purchases should rise from $1.7 million to $3 million over the period. The sector has a total of about 87 laboratories, mostly engaged in quality control. Some of the larger laboratories also engage in research, primarily concerning the adaptation of products to local supply conditions, and in productivity studies.

Many of the large companies in this sector are foreign owned and utilize wholly imported technology. Vulcan Material Plastico S.A. operates the largest laboratory in the sector; others are maintained by local subsidiaries of Goodyear, Firestone, and Orion. The Vulcan laboratories have developed a large number of new products, but most of the rest perform only quality control, materials analysis, and testing. The principal methods used for such work are gas chromatography, optical microscopy, and spectrophotometry. Minicomputers or other EDP methods have not yet been introduced.

The following instruments should continue to have a favorable sales potential in the sector:

- pH meters
- Colorimeters
- Photometers
- Spectrophotometers
- Spectrometers

Other laboratories.—Most other industrial laboratories in Brazil engage primarily in quality control or testing activities, which will expand with industrial development. At present, equipment requirements tend to center on conventional instruments, but demand for advanced instruments is increasing as the country's industrial base develops. Three major purchasers of laboratory instruments are the Cia. Vale do Rio Doce, operating the largest laboratories in the primary metals industry; Industrias Klabin do Parana Celulose S.A., a major producer of paper and paperboard; and the Companhia de Cimento Portland Itau, the country's leading cement manufacturer.

Trade and Technical Regulations

Brazil assesses import duties of 9% to 15% on most categories of laboratory instruments. Duty rates on items similar to those produced domestically, however, range up to 70%. In addition to paying duties, importers must at present make a prior deposit of 100% of f.o.b. value to the Bank of Brazil on all goods dutiable at 37% or higher. Information concerning duty rates and import regulations may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The characteristics of Brazil's power supply are 120/220 volts, 60 hertz, 3-phase, with 220/440 volts, 60 hertz, 3-phase available for heavy industrial use. Equipment must bear permanent labels describing any electrical characteristics.

The metric system of weights and measures is the statutory standard in Brazil. Information on the availability of published standards for laboratory instruments in Brazil may be obtained through the American National Standards Institute, 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Brazil is available on a continuing basis from:

**Country Marketing Manager-Brazil
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230**

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

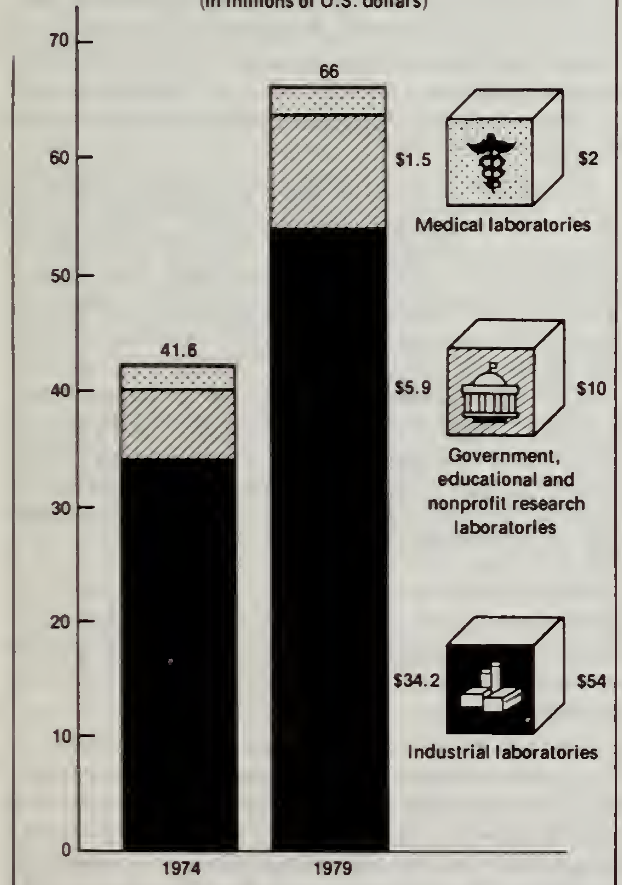
**National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543**

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications, and trade and professional associations. Please request: "The Market for Laboratory Instruments— Brazil," DIB 75-10-500, March 1975.

Czechoslovakia

Long considered among the world's industrialized nations, Czechoslovakia intends to step up investment in research and development (R. & D.) programs, to spur a major expansion of its chemical industry and to modernize technology in other sectors, notably metallurgy and machine building. The central economic planning authorities view intensified product development efforts as essential to improving the country's export position. At the same time, they have assigned a high priority to research aimed at improving domestic labor productivity.

Figure 1.- Czechoslovakia: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Source Bureau of International Commerce, Office of International Marketing research report; values based on Czechoslovak trade source estimates.

Under these conditions, research and test laboratories anticipate growing requirements for sophisticated instrumentation that should provide good sales opportunities for U.S. suppliers.

With the initiation of the policy providing generous funding for research, Czechoslovak purchases of laboratory instrumentation expanded by more than 40% from $28.9 million[1] in 1972 to $41.6 million in 1974. A further 8% increase was registered in 1975 when the market approached $45 million. Based on current plans, steady growth to a level of $66 million in 1979 is forecast, indicating an annual average growth rate of 9.8% for the 1974-79 period.

Allocations for total laboratory expenditures are projected to rise at an average annual rate of 10.9% from $620 million in 1974 to $1.04 billion in 1979. The level of funding should provide for extensive expansion in instrument purchases by all sectors, but industrial laboratories will remain the principal consumers, accounting for over 80% of total instrument purchases. Industrial laboratories alone are expected to spend $54 million on instruments in 1979, by contrast with $34.2 million in 1974. Growth is also forecast for government and university laboratory expenditures and instrument purchases, and for those of medical establishments (see figure 1).

Competitive Environment

Although Czechoslovakia produces and exports a range of high-quality laboratory instruments, it is heavily dependent on imports for advanced-technology and specialized items; a substantial proportion of such

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[1] U.S. $1.00 = Kcs. 13.20 (1972 and 1973); U.S. $1.00 = Kcs. 11.81 (1974 and subsequently).

Table 1.—Czechoslovakia: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	23.9	30.7	33
Imports	15.6	22.5	24
Exports	10.6	11.6	12
Market size[1]	28.9	41.6	45

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[1] Market size equals production plus imports minus exports.

Source: Values based on Czechoslovak trade source estimates.

imports comes from leading Western manufacturers. Additionally, the country imports quantities of conventional items, manufactured preferentially under joint specialization agreements, from its Communist partner countries in the Council for Mutual Economic Assistance (COMECON). Indications are that both import categories will expand as plans for domestic economic development and further integration with COMECON progress. Trade sources predict an average annual import growth rate of about 11% over the 1974-79 period, bringing total imports of laboratory instruments to $38 million in the latter year.

Purchases from the United States, however, are expected to increase even more rapidly in view of the trend toward use of advanced equipment. The U.S. share of the import market for laboratory instruments, which amounted to 10.5% or $2.36 million in 1974, is projected to reach 12.5% or a value of $4.7 million in 1979.

Sales of U.S. instruments benefit from a general preference for Western technology among professional Czechoslovak laboratory personnel; products from the West are relatively well known and highly regarded. They are purchased to the extent that technological superiority can overcome cost considerations and sufficient hard currency is available. Although the size of the initial outlay has often mitigated against the selection of American products in the past, recent evidence suggests that end users and trade officials are increasingly willing to weigh performance characteristics affording long-run economies of operation.

Examples of U.S. products that currently have a market advantage are nuclear magnetic resonance (NMR) spectrometers, X-ray spectrometers, and sophisticated electronic and optoelectronic instruments, such as high-performance oscilloscopes (see table 2). Future demand should center on these and similarly advanced items, including automated instruments and those incorporating "easy-to-handle" design features.

A number of U.S. instrument manufacturers have entered the Czechoslovak market. Some of the more active firms and their principal products are Perkin-Elmer (gas and liquid chromatographs, X-ray spectrometers, thermal analyzers, and NMR spectrometers); Nuclear Chicago (radiation measuring equipment); Orion Research (ion specific electrodes); Beckman Instruments (densitometers); and Tektronix (high-performance oscilloscopes). Additional manufacturers whose products are represented include Packard Instruments, Hewlett-Packard, Varian, Technicon, and Digital Equipment Corporation (DEC).

The leading third-country suppliers of laboratory instruments and their estimated 1973 market shares are East Germany, 30%; West Germany, 20%; and Hungary, 15%. COMECON protocols establish East Germany and Hungary as the favored suppliers of specified types of instruments, and Czechoslovakia has long-term contractual obligations to these countries covering imports of laboratory instruments they produce, as well as exports of instruments manufactured domestically. East German shipments range from advanced optical equipment manufactured by VEB Carl Zeiss, Jena, and other leading firms, to conventional balances and centrifuges. Hungary specializes in electrochemical articles, ultracentrifuges, medical technical equipment, autoanalyzers, instruments for the food industry, and complete laboratory installations. The only other significant COMECON supplier is the Soviet Union, which furnishes some X-ray measuring instruments and testing apparatus.

Purchases from West Germany have included electronic analytic instruments, both optical and nonoptical; optical and nonelectronic instruments; and testing and evaluation equipment. As is the case with imports from other Western nations, a high proportion of instruments manufactured under U.S. license is included.

In addition to firms in the United States and West Germany, important free-enterprise suppliers of laboratory instruments are found in Austria, Switzerland, France, the Netherlands, the United Kingdom, and Japan. European manufacturers benefit to some extent from their proximity to the market and the existence of trade channels. Having built up their trade with Czechoslovakia during a period when business conditions were difficult, Austria and Switzerland function as important transit centers for instruments. Austria has also become the principal service base for third-country instrument manufacturers selling to the COMECON area.

Switzerland is a major source of supply for precision instruments, and France and the Netherlands for electronic instruments. Japanese industry is gaining entry to the market through sales of optics and optoelectronics.

Limited by the size of the domestic market, the Czechoslovak laboratory instrument manufacturing industry has specialized in the production of mechanical measuring equipment, electron microscopes, medical analytical instruments, and X-ray equipment. Technology is generally high, and some instruments are exported to Western as well as to COMECON nations.

Production takes place in approximately 30 plants, most of which are operated by one of eight specialized industrial "trusts." The two largest establishments, Laboratorni Pristroje and Tesla, together account for about one-half of total output. The two are under the jurisdiction of the Federal Ministry of General Engineering. The first manufactures chromatographs and polarographs and a range of other items; the second concentrates on electric and electronic instruments such as oscilloscopes, electron microscopes, NRS spectrometers, and laser equipment. Each had estimated instrument sales in excess of $10 million in 1974.

The other principal manufacturers are Metra-Blansko (digital measuring equipment, thermostats, and thermometers); Meopta (optomechanical instruments); Chirana (X-ray equipment and medical laboratory equipment); Labora (conventional equipment); Zavody Presneho Strojirenstvi (mechanical measuring equipment); and Jan-Sverma (mechanical precision instruments). Most of these enterprises sold at least $5 million in laboratory instruments in 1974.

Czechoslovak industry also produces amino acid analyzers, based on Teflon-coated tubes imported from the United States. The instruments, manufactured by Microtechna, are offered in "A-800" and "A-810" models, and incorporate a recorder and photometer.

Expansion of the industry has a high priority within the planning framework which correlates with the emphasis placed on R. & D. The authorities envisage a tenfold increase in the production of electronic measuring equipment and a similar expansion for optomechanical equipment. Exports should also become more important, because the COMECON program calls for Czechoslovakia to become the principal supplier of amino acid analyzers, NMR spectrometers, and certain other instruments to member countries.

Selected instrument markets.— The following analysis indicates some of the major product trends in Czechoslovakia (see table 3).

Gas chromatograph purchases should substantially increase above the current level of 60 to 80 units annually as the petrochemical and drug manufacturing industries expand. The outlook for sales of U.S. instruments is very good, due to mounting requirements for precision as well as the inherent benefits of reduction in size of necessary samples. Domestic production consists of the "CHROM 4," produced by Laboratorni Pristroje: this modularly constructed, double-column chromatograph operates with interchangeable detectors for thermal conductivity and flame ionization. Work is in progress to equip the instrument with additional detectors. Trade sources believe that electronic integrators and instruments based on other principles of operation will continue to be imported.

Gas chromatographs are primarily imported from East Germany (VEB Chromaton). Other countries, however, also furnish instruments. Among the leading firms represented are Hewlett-Packard (United States); Perkin-Elmer and Varian (both firms have U.S. and West German production); and Packard Delft (United States and the Netherlands).

Table 2.—Czechoslovakia: Imports of selected laboratory instruments, 1972-1974

(in thousands of U.S. dollars)

	1972	1973	1974
Optical disposing and other optical instruments			
United States	330	710	
West Germany	1,470	2,100	
East Germany	1,310	1,680	
Hungary	980	1,260	
Others	2,160	2,660	
Total	6,550	8,410	8,880
X-ray dispersing instruments			
United States	40	1500	
Switzerland	350	400	
Netherlands	100	150	
Soviet Union	40	100	
Others	170	200	
Total	700	1,000	1,350
Radiation measuring instruments			
United States	130	300	
East Germany	90	90	
U.S.S.R.	40	40	
Hungary	40	40	
Others	70	40	
Total	370	510	590
Mass spectrometers, gas and liquid chromatographs			
United States	80	180	
West Germany	200	300	
East Germany	200	240	
Netherlands	120	180	
Others	180	300	
Total	780	1,200	1,350
Electron spin resonance, nuclear magnetic resonance, and electron scattering instruments for chemical analysis			
United States	20	80	
West Germany	110	120	
France	70	110	
Japan	30	60	
Others	50	50	
Total	280	420	520

Source: Values based on official Czechoslovak trade statistics and trade source estimates.

The market for ***liquid chromatographs***, notably high-performance liquid chromatographs (HPLC), should also expand as modern methods are applied to basic research in high-priority fields such as petrochemistry, biochemistry, biophysics, and medicine. Although at present all HPLC's are imported, domestic production will probably expand, limiting the import market to highly sophisticated instruments.

Liquid chromatographs are supplied by Beckman Instruments (United States and West Germany); Knauer (West Germany): Carlo Erba (Italy); and LKB Produktor (Sweden).

Interest in ***mass spectrometers*** centers on quadrupole-dodecapole instruments for use as detectors with gas chromatographs. U.S. manufacturers should find a growing market because of the relatively low price, operational simplicity, and high resolution

Table 3.—Czechoslovakia: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatographs	800	80	400	320	1,600	240	560	800
Liquid chromatographs	400	80	220	100	1,000	100	500	400
Mass spectrometers	500	100	400	—	900	225	495	180
NMR spectrometers	600	120	330	150	1,200	180	540	180
pH meters	300	6	144	150	500	15	235	250
Densitometers	600	30	570	—	1,000	50	750	200
Thermal analyzers	200	40	160	—	400	80	320	—
X-ray analyzers	1,000	150	850	—	1,700	125	935	340
Oscilloscopes	800	160	240	400	1,300	325	195	780
Nuclear detection instruments	700	280	210	210	1,300	585	260	455

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[6] Source: Values based on Czechoslovak trade source estimates.

features of their products. Other sources of imports in the past have included Carl Zeiss Jena (East Germany); Varian (United States, West Germany, and Switzerland): AEI (United Kingdom); and Jeolco (Japan).

Czechoslovak laboratories use ***NMR and electron spin resonance (ESR) spectrometers*** primarily for research purposes rather than routine examinations. Imports satisfy about 75% of their requirements. Current demand centers on inexpensive equipment with simple recorders, but a shift toward digitalized computer-interfaced instruments for use by the leading scientific institutes is expected. Perkin-Elmer (United States), Schlumberger (France) and Varian (United States) are among the foreign firms that have supplied inexpensive instruments in the 200- to 220-millicycle (mc) range. Jeolco (Japan) and Bruker-Physic (West Germany) have sold a few more expensive instruments with computers and high-frequency resolution.

pH meters for use in the food and chemical industries and for medical and ecological research also offer an expanding market, including those with special electrodes such as the ones supplied by Orion Research (United States). However, most of the supply comes from domestic sources (Laboratorni Pristroje and Crytur offer ion-specific and glass electrodes), and from East Germany (Forschungsinstitut Meinsberg), and Hungary. The principal West European firms represented are Radiometer (Denmark), whose instruments are widely used for testing blood albumen; WTW Wissenschaftlich-Technische Werkstatten (West Germany); and Tacoussel-Solea (France).

Densitometers are in growing demand for use with conventional chromatographic and electrophoretic methods in medical and biological research. Monochrometers and thin-layer scanners with automatic recording instruments should have particularly good sales potential as scientists shift away from filter densitometers. Instruments are supplied predominently by Zeiss (East Germany), and MOM (Hungary), but Western products are purchased when high technical standards must be met. Among the leading Western suppliers are Spex (United States); Beckman Instruments (United States and West Germany), and Kipp & Zonen (the Netherlands). The U.S. products have a reputation for excellent monochromatic efficiency.

The growth of the metal, machine building, and chemical industries should considerably expand purchases of ***thermomechanical analyzers, thermogravimetric analyzers,, and differential thermal analyzers***. The principal suppliers are Perkin-Elmer (United States and West Germany); Netsch, and Linseis (both of West Germany). Some instruments also come from VEB Laborelektronik, Halle (East Germany). Despite the trend toward intensified German competition, U.S. manufacturers should be able to retain a large share of the market with sales of advanced instruments.

An exceptional growth rate is forecast for ***energy dispersive X-ray analyzers*** because of their comparatively low cost and wide range of possible applications in research and testing. U.S. firms such as Tracor and Ortec, are the principal suppliers of this equipment. The metal industries, however, are expected to use parallel channel analyzers increasingly. ARL Bausch & Lomb (Switzerland) and Soviet producers have been the leading sources of multichannel equipment to date. East Germany and the Soviet Union also have furnished sequential analyzers.

Versatile, plug-in ***oscilloscopes*** will probably continue to be in strong demand. Requirements for sampling oscilloscopes are also expected to increase. A domestic manufacturer, Tesla, offers an efficient plug-in instrument, but more sophisticated or specialized equipment is imported. Examples of foreign-made instruments that are of interest include the constant deflection frequency equipment manufactured by

Tektronix (United States) and the digitalized sampling oscilloscope manufactured by Nicolet (United States). Among the third-country suppliers are VEB Messelektronik (East Germany), Marconi (United Kingdom), and Schlumberger (France).

Nuclear radiation detection instruments are increasingly used in medical research, biochemistry, and in nuclear physics. Proportional counters are declining in demand as gamma-scintillation and semiconductor (solid-state) methods become available. Although Tesla produces detection instruments for industrial use, and Laboratorni Pristroje manufactures medical nuclear equipment, most advanced instrumentation is imported, principally from the United States. The U.S. firm, Nuclear Chicago, alone supplies an estimated 30% of the entire market. Although East Germany and the Soviet Union also furnish some equipment, trade sources indicate that COMECON manufacturers are encountering difficulty in meeting the rising level of demand.

Major Purchasers

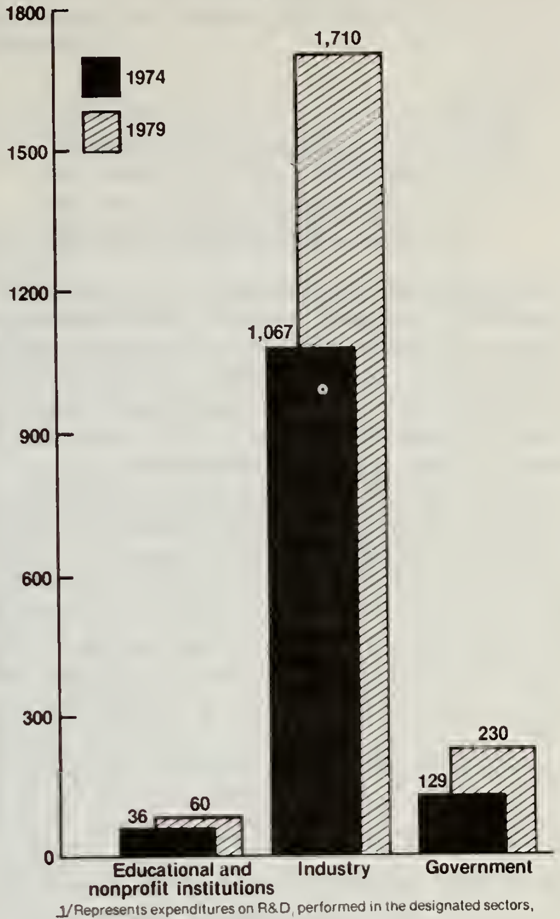
A market research study recently conducted in Czechoslovakia for the Office of International Marketing, Bureau of International Commerce, reveals a trend toward the consolidation of Czechoslovak R. & D. efforts into large, centrally directed programs. The priority assigned research is evident from the allocation of $3 billion in operation funds alone in a special R. & D. budget under the current Five-Year Plan (1970-1975). Czechoslovak planners indicated that total R. & D. expenditures amounted to 3.6% of gross national product in 1974, although 25% to 30% of such expenditures are absorbed by social science research.

The total funds available for R. & D. purposes are projected to increase from $1.2 billion in 1974 to $2 billion in 1979, representing an average annual growth rate in excess of 10%. About 40% of the funding comes directly from the state budget and the remainder from the budgets of specific industrial trusts operating under various ministries. All funds and projects are therefore subject to governmental approval in the central planning process. Overall jurisdiction is exercised by the Ministry of Technology and Investments. Individual industrial establishments, however, are now being permitted wide latitude in setting the sums they wish to allocate.

The use of R. & D. funds is about 85% by industry, 10% by Government, and 5% by educational and nonprofit institutions (see figure 2). The Government subsidizes both educational and industrial research and has recently also channeled funds to independent laboratories that service industry on a contract basis. About 3% of total funds are spent on laboratory instruments.

In basic research, which consumes about 10% to 15% of R. & D. funding, activities are closely correlated with economic development priorities. Major fields of interest are microstructure and the properties of materials, control and techniques of new chemical processes, biophysics, medicine, and ecology. Applied research accounts for an additional 30% to 35% of funds, and product development the remainder.

Figure 2. Czechoslovakia: R&D expenditures, 1974 and 1979
(in millions of U.S. dollars)



1/Represents expenditures on R&D performed in the designated sectors, regardless of the original source of funds.

Source: Values based on Czechoslovak trade source estimates.

In industrial research, priorities are given to developing chemical fibers and other materials, upgrading technology and improving productivity in metallurgy and machine building, and producing materials based on nonferrous metals and powder metallurgy. Additional areas of inquiry include electronics, telecommunications technology, applied cybernetics, complex utilization of wood substances, nuclear technology, nutrition, industrial safety, and hygiene.

The number of scientists, engineers, and technicians employed in 1974 was 71,000 (see table 4). Most received their training in local institutions. Formerly, some scientists were educated in Austria or Germany; at present their international exposure consists of limited postgraduate exchanges within COMECON. Very few have yet been sent to Western countries.

Government laboratories. There are about 350 laboratory facilities operated directly by agencies of the

Table 4.—Czechoslovakia: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists				
	Physics	Chemistry	Other life[1]	Engineers	Technicians
Employed by:					
Goverment	750	500	1,800	3,000	3,000
Industry	750	500	1,800	3,000	3,000
Educational and nonprofit institutions	250	300	1,200	1,500	1,500

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[1] Universities and technical high schools only.

Source: Czechoslovak Statistical Yearbook; breakdowns are trade source estimates.

Government, and by universities. Their activities are coordinated principally by the Czech Academy of Science and, to a lesser extent, by the rapidly expanding Slovak Academy of Science. The organizations in effect supervise many of the more important government and education research institutes in the country, and they directly operate some central institutes.

Government laboratory expenditures and instrument purchases are expected to reach $300 million and $10 million, respectively, in 1979, increasing more rapidly than those of the other sectors (see table 5). Anticipated growth is attributed to the planned geographic dispersal of facilities, heavy instrument requirements stemming from general conditions of short supply and inadequacy, and expected progress in established research areas.

Government laboratories concentrate principally on nuclear research, the rationalization of industry and productivity improvements, energy, chemical materials, and food production. They also develop, test, and evaluate methods and equipment for laboratory use.

Only about 40 government laboratories have annual expenditures in excess of $1 million, but such laboratories employ advanced methods, and account for about one-half of total instrument purchases. Among the analytical techniques they use are chromatography, electrometric methods, electron paramagnetic resonance (EPR), mass spectrometry, radiometric methods, and X-ray methods. Some have purchased instruments to be used with computers and minicomputers, and trade sources believe that efficiency and prestige factors will prompt wider use.

Instruments with good sales potential in the government sector include the following:

Liquid chromatographs (including HPLC)
Electron microscopes combined with with energy dispersive X-ray fluorescence spectrometers
Mass spectrometers
Multichannel analyzers
Minicomputers for laboratory instruments
Holographic equipment
Laser measuring equipment

Medical laboratories.— Of the estimated 450 medical laboratories in Czechoslovakia, about 25 spend over $1 million annually. Such large facilities account for 40% to 50% of total instrument purchases. The Government's intention to continue improving the nation's health standards and to boost exports of pharmaceutical materials and dental equipment is expected to raise sectoral expenditure from $45 million in 1974 to $70 million in 1979, and instrument purchases from $1.5 million to $2.5 million in the same 5-year span.

Much of the equipment increase should go to supply diagnostic laboratories with automated or semiautomated instruments to replace manually performed analyses. The number of examinations performed is increasing, and medical technicians are scarce. Domestic research institutes are working on the development of a semi-automatic analyzer to reduce manual operations.

Imports are apt to consist primarily of ultraprecise instruments for medical research on cancer, nutrition, occupational diseases, and other health problems, and to assist in the improvement and further refinement of medical and dental equipment currently produced, such as cardiac pacemakers. In general, the medical research effort has very high technical standards.

Laboratory techniques in use include chromatography, colorimetry, electron microscopy, electrophoresis, mass spectrometry, and radiometric methods. The central research institutes have IBM computers and run computer-controlled experiments.

Future demand in this sector is expected to center on the following equipment items:

Amino acid analyzers
Sequential and multichannel automatic analyzers
Radiometric equipment for enzyme diagnosis
Gas chromatographs
Liquid chromatographs
Electron microscopes, other microscopes

Laboratories in the chemical industry.— Although recent increases in petrochemical prices are forcing a re-examination of specific goals, trade sources believe that the forced promotion of the chemical industry will remain a matter of the highest priority in the Czechoslovak economy. Plans call for development of the capability to develop sufficient fertilizer and pesticides for use in the agricultural sector; development of artificial fibers to reduce dependence on textile imports; and achievement of Czechslovak importance as a world exporter of pharmaceutical products, dyes, lacquers, and textile finishing chemicals. It is also to become the principal supplier of various refined chemicals for the entire COMECON area. According to projections, the industry by 1990 should quadruple its 1973 output level. The value of production in 1973 was $2.8 billion, and investment approached $450 million.

As implementation of these plans progresses, the industry's laboratory expenditures are expected to increase from $90 million in 1974 to $200 million in 1979, representing an average annual growth rate of over 17%. In the same 5-year span, instrument purchases should rise from $4.7 million to $10 million.

The industry maintains about 240 laboratories, operated both by small plants and by large trusts. Only about 20 of the facilities have expenditures of more than $1 million annually, but the 10 largest account for 35% to 40% of total instrument purchases. The total number of scientists employed is approximately 2,000, most of whom are chemists.

The large laboratories do research in petrochemistry, macromolecular chemistry, organic synthetics, rubber and plastics, synthetic fibers, inorganic chemicals, thermosetting synthetic resins, polymer ion-exchangers, and pharmaceuticals. Their product development efforts primarily concern processed oil derivatives, synthetic fibers, fertilizers, pharmaceuticals, textile finishing preparations, plant protective agents, organic dyes, and photochemicals.

Techniques include chromatography, colorimetry, electron paramagnetic resonance (EPR), mass spectrometry, and radiometric methods. Although little electronic data processing (EDP) equipment has yet been installed, the authorities have indicated interest in data reduction equipment for use with chromatographs and electrochemical instruments which would be suitable for laboratories in this sector.

The following laboratory instruments are expected to be in strong demand by industrial chemical laboratories:

- Gas chromatographs
- Polarographs
- Electrochemical total oxygen demand analyzers
- NMR and ESR with permanent magnets
- Quadrupole mass spectrometers

Laboratories in the primary metals industry. These facilities are expected to increase purchases of laboratory instruments from $2.7 million in 1974 to $4.3 million in 1979 as the authorities emphasize the qualitative improvement of output Czechoslovak steel production had a total value of $5.7 billion in 1972. Planning calls for increased production of electro- and high-grade steel, chassis sheets, tinned and galvanized sheets, and steel alloy products. Among the non-ferrous metals, the production of copper and tin sheets, sinter carbides and powder metallurgy are receiving high priority.

The industry has about 90 laboratories, which employ between 1,500 and 2,000 scientists. With annual expenditures in excess of $1 million, about 15 facilities are classified as large, and they account for an estimated 35% to 40% of total instrument purchases in the sector. Some of these facilities are operated directly by steel mills; others function as industrially financed institutes.

Preferred analytical methods include electrometric methods, electron microscopy (especially in connection with spectrometry), magnetic sueceptibility, radiometric methods, thermal methods,and X-ray methods. EDP

Table 5.—Czechoslovakia: Laboratory expenditures by major end users, estimated 1974 projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments[1]	
		1974	1979	1974	1979
Government, educational, and nonprofit institutions	350	160	300	5.9	10.0
Medical organizations	450	45	70	1.5	2.5
Industry:					
Food products	500	45	50	2.5	2.8
Chemicals (including rubber and plastics)	240	90	200	4.7	10.0
Petroleum (including oil and gas extraction)	10	25	40	1.0	1.7
Stone, clay, and glass	40	30	40	1.0	1.3
Primary metals	90	45	70	2.7	4.3
Fabricated metal products	60	30	40	1.7	2.2
Transportation	90	50	80	2.5	3.9
Other	770	100	150	18.1	27.6
Total	2,600	620	1,040	41.6	66.3

Source: Czechoslovak Ministry for Technology and Investment and trade source estimates.

equipment is presently little used, and trade sources do not expect that minicomputers will be widly applied to the near future.

Instruments with the most favorable sales prospects in this sector are:

- Spectrometers, UV-vacuum, and X-ray
- Energy dispersive X-ray fluorescence spectrometers
- Ion specific analyzers
- Ultrasound thickness meters
- Measuring instruments for galvanic coatings
- Auger and ESCA instruments
- Electrochemical analyzers for galvanics

Other industrial laboratories.— Czechoslovakia's development plans also focus on increasing and improving the production of the machine building industry and boosting energy production. Tesla, the manufacturer of some of the country's most advanced laboratory instruments, maintains large research laboratories concerned with investigation in radio communications systems, special materials for electronics, microwave and photoelectronic image devices, laser, electrovacuum equipment, communications equipment, and ferrite elements. Trade sources anticipate other large industrial establishments performing research will have expanding equipment requirements, and that efforts to improve technology will increasingly favor purchases of advanced instruments.

Trade Practices and Technical Regulations

Czechoslovakia does not usually levy customs duties on imports of equipment for state institutes or nationalized enterprises but does require prior authorization and the allocation of foreign exchange within the framework of its foreign trade plan. Where duties are levied they rarely exceed 6% of the F.O.B. price. Greater flexibility may be possible under licensing and barter arrangements. To obtain import approval, end users must furnish testimony that the desired instrument is not available from domestic or other COMECON sources.

Foreign trade is a state monopoly administered by foreign trade organizations (FTO's) operating under the jurisdiction of the Ministry of Foreign Trade. These agencies have sole power to conduct sales negotiations and conclude contracts, although they may not change specifications set by the end users. The FTO's responsible for trade in laboratory instruments are Kovo, 47 Dukelskych Hroinv, 17005 Prague 7, (TELEX: 121481) and Merkuria, 38 Argentinska, 17005 Prague 7 (TELEX: 121022).

In making purchasing decisions, the FTO's consider at least three competitive bids. Price and credit terms are important factors, but when they are comparable, the choice may be based on the availability of maintenance and repair services and parts supply. The Czechoslovak buyers seldom seek out foreign instrument manufacturers, relying instead on the sellers to remain in close contact with them.

The FTO's normally require that prices remain fixed over lengthy periods of time to accommodate delays in the approval process and the availability of foreign exchange, and often ask for price concessions at the conclusion of sales negotiations. Requests for favorable credit terms may also be expected. Trade officials customarily reject contracts carrying interest rates in excess of 6.5% per annum, and they often try to obtain interest-free grace periods of up to 12 months. Experienced suppliers consider these factors in supplying quotations.

Trade sources stress the importance of active sales promotion and frequent personal contact with trade officials and end users and note that the latter should be supplied with full product information. It is possible to advertise directly in trade publications and, with the collaboration of Czechoslovak organizations that are set up to assist foreign firms, to arrange exhibitions and other promotional activities. Two establishments, "Rapid," and "Made in . . . Publicity" offer such services. Additional exposure can be obtained through participation in the annual Brno Industrial Fair.

Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4325, Main Commerce Building, Washington, D.C. 20230.

Czechoslovakia uses the metric system of weights and measures. The domestic electric power supply throughout the country is 200/380 volts, 50 hertz, 3-phase; 4-wire ground connections are used.

Technical standards are issued by Urad pro Normalizaci a Mereni, Vaclavske nam. 19, Praha, C.S.S.R. Information on the availability of published standards for laboratory instruments in Czechoslovakia may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018. An additional source is the Czechoslovak Chamber of Commerce (Ceskoslovenska Obchodni Komora), Argentinska 38, Prague 7, Czechoslovakia.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Czechoslovakia is available on a continuing basis from:

Country Marketing Manager-Czechoslovakia
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

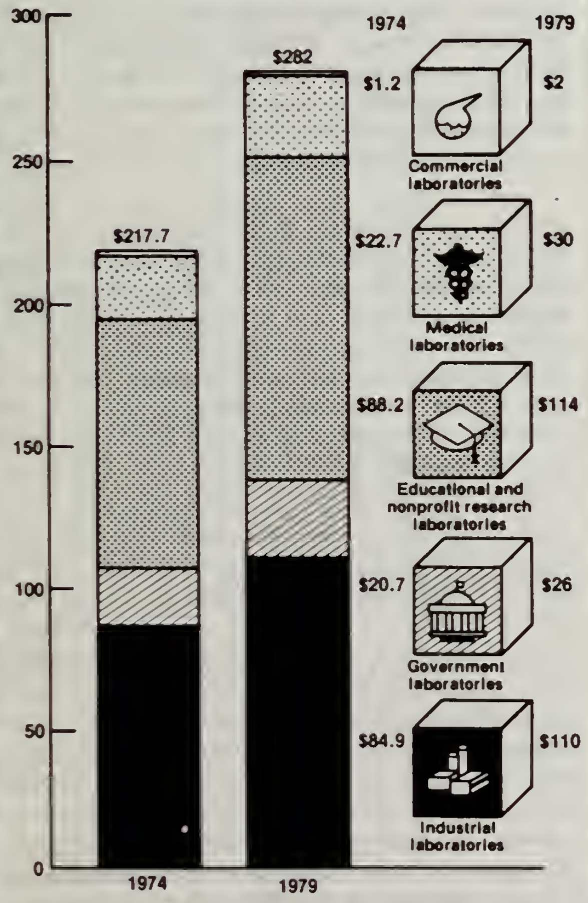
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Czechoslovakia," DIB 75-07-511, March 1975.

Germany

Germany can attribute much of its prominence among the world's industrialized nations to its substantial research and development (R&D) efforts in all areas of science and technology. The market for laboratory instruments to support these efforts is large and growing. Trade analysts project purchases of over $280 million[1] in 1979 and an average annual growth exceeding 5% during the 1974-79 period (see figure 1). German laboratories spent $144 million for instruments in 1972, about $218 million in 1974, and an estimated $230 million in 1975 (see table 1).

Figure 1. Germany: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report; values based on German trade source estimates

Pressure for additional research activity is enormous in Germany, and all types of R&D establishments are planning to acquire more instrumentation. The energy crisis has been a major stimulus for intensive studies of fuel conservation and development.

Educational and nonprofit research laboratories, the largest instrument end-user group, expect to increase instrument purchases from over $88 million in 1974 to $114 million in 1979 to keep pace with the growing demand for R&D. Sales of instruments to government laboratories are predicted to reach $26 million in 1979.

German industry, which depends largely on exports, considers application of the newest and most advanced techniques essential to economic survival. The industrial market for laboratory instruments is projected to rise from almost $85 million to $110 million annually during the 1974-79 period.

Substantial sums are being spent on medical research in an effort to satisfy popular demand for better medical services. Prophylactic medicine, with its heavy requirement for laboratory equipment, is rapidly gaining importance. Medical laboratories as a group are forecast to spend $30 million for instruments in 1979, a sizable increase over the 1974 total of nearly $23 million.

Competitive Environment

German laboratories buy a large number of highly specialized and sophisticated instruments from foreign firms. Purchases of imported instruments, which amounted to $94 million in 1974, are expected to increase an average 8% anannually, totaling nearly $140 million in 1979.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: US$1.00 = DM 3.19 (1972); DM 2.67 (1973); DM 2.51 (1974 and subsequent years).

U.S. laboratory instruments enjoy an excellent reputation in Germany. More than one-third of all imported equipment are supplied by firms in the United States (see table 2). U.S. sales in Germany are expected to grow from $33 million in 1974 to nearly $50 million in 1979. These figures do not include the large number number of instruments provided by U.S. firms with production facilities in Germany or other foreign countries.

Table 1.—Germany: Size of market for laboratory instruments, 1972, 1974, and estimated 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	198	305	320
Imports	44	94	110
Exports	109	181	200
Market size[1]	144	218	230

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[1] Market size equals production plus imports minus exports.
Source: Values based on German trade source estimates.

American subsidiaries play an exceptionally important role in domestic production. Beckman Instruments, Varian, Perkin-Elmer, Hewlett-Packard, and others manufacture their highly sophisticated instruments for local consumption and export. Each of these four companies has sales exceeding $10 million annually, and together they account for 20% to 25% of German output.

End-users are particularly impressed with the optical components, electronic features, superior digital techniques, and modular construction used in U.S. laboratory instruments. The high performance and maximum accuracy of U.S. products have given some American manufacturers a virtual monopoly in various market sectors. Ortec is one of the leaders in X-ray fluorescence- and luminescence-measuring instrument sales. Nuclear Chicago occupies a very strong position in the market for nuclear radiation-measuring equipment, liquid scintillation counters, and gamma sample changers. Digital Equipment Corporation is the undisputed leader in the field of minicomputers and computers for gas chromatographs and mass spectrometers.

Other major U.S. suppliers include Tektronix (making precision oscilloscopes); Technicon (autoanalyzers for continuous operation); du Pont de Nemours, Analytical Instruments Division (liquid chromatographs and thermal analyzers); and Finnigan (combined gas chromatographs and mass spectrometers and gas analyzers). Fisher Scientific Corporation is among the five most important suppliers of spectrometers and atomic absorption spectrometers.

The German laboratory instruments manufacturing industry is well established and optimistic about future growth. Production is projected to rise an average 8% annually, going from $305 million in 1974 to $445 million in 1979. The government-sponsored technology program aids industry through direct subsidies for certain research projects. For example, the Government contributed $12 million for the optical and electronic measuring instrument project in 1974, and a $16-million budget is anticipated for 1976.

The industry is export oriented, with no less than 60% of output destined for overseas consumers. Exports, totaling $181 million in 1974, are projected to increase by nearly 11% annually and to top $300 million in 1979.

The domestic industry comprises approximately 450 companies, most of them small and medium-size firms specializing in the manufacture of specific instruments. Almost half the German market is supplied by the 15 largest firms, including such giants as Siemens AG, with laboratory instrument sales approaching $60 million annually. Two major companies, Carl Zeiss and Ernst Leitz produce electron microscopes, specialized spectrometers, photometers, and other sophisticated items. Five manufacturers have instrument sales exceeding $10 million a year: Heraeus Heraues-Christ, (supplying thermal analyzers and centrifuges); Eppendorf Geratebau Netheler und Hinz (photometers and automatic analyzers); Frieseke & Hoepfner (nuclear radiation measuring instruments); Bruker Physik AG. (nuclear magnetic resonance, electron spin resonance and infrared spectrometers); and Dr. Bruno Lange GmbH. (photometers and electrophoresis scanners).

Suppliers from other foreign countries are considerably less important in Germany than U.S. firms. The second largest share of the import market is held by Dutch companies—particularly Philips, Enraf-Nonius, and Packard-Becker (a U.S. subsidiary located in the Netherlands)—which supply electronic and electrochemical laboratory instruments in relatively large volume. Philips also manufactures some items in Germany. The close economic interrelationship between Germany and the Netherlands contributes to the successful promotion of Dutch products.

Substantial quantities of analytical and electronic balances and centrifuges are imported from such Swiss firms as Mettler Instruments, Metrohm, Contraves, and Applied Research Laboratories (a U.S. subsidiary in Switzerland). Swiss technology is considered highly advanced, especially in precision instruments and optics.

British industry is particularly competitive in the field of electronic laboratory instruments. Major U.K. suppliers include Rank Precision Industries, Cambridge Instruments Co., and AEI Scientific Apparatus.

Japanese industry has succeeded in promoting optical and electronic microscopes during the past few years and is progressively invading other sectors of the German laboratory instrument market. The combination of high quality and reasonable price has made Japan a leading source of optical instruments. Major manufacturers include Shimadzu Seisakusho, JEOL, Rigaku Denki, and Hitachi.

Other leading third-country suppliers include Carlo Erba, Optica, and Laben of Italy; LKB Produkter of Sweden: Radiometer of Denmark; and Nokia of Finland. Intertechnique, a French manufacturer, has established an excellent market position for multichannel analyzers. Denmark's Bruel & Kjaer is the market leader in the field of sound and vibration measuring instruments.

Selected instrument markets.—Research recently conducted in Germany for the U.S. Department of Commerce, Office of International Marketing, analyzed the sales potential for 15 selected instruments(see table 3).

German purchases of ***gas chromatographs*** are expected to grow from $6 million in 1974 to $9 million in 1979. End users prefer to purchase instruments with interchangeable detectors although flame ionization detectors are most commonly used. Combinations of gas chromatographs and mass spectrometers have become widely accepted. Sales are expected to increase for gas chromatographs with integrators and computer interface capabilities. All improvements such as automatic operation, more rapid response rates, higher accuracy, and easier maintenance will be appreciated by German end users. American leadership in this field is undisputed, and most of the gas chromatographs used in Germany are purchased from U.S. manufacturers and their subsidiaries around the world. The main exception is Carlo Erba of Italy, a major supplier of low-cost instruments.

Trade sources predict an average annual growth of 21% in sales of ***liquid chromatographs*** during the 1974-79 period. Liquid chromatography only recently has been developed into a very versatile measuring method and a backlog of instrument orders now exists. More extensive applications of this method can be expected once the slow operating speeds are overcome. Ultraviolet spectrometers are the most commonly used detectors; light and differential refractometers are only of minor importance. Interest is growing in variable monochromatographs and methods enabling more specific identification of the various fractions. The trend is toward more rapid performance and greater ease of operation. U.S. firms and subsidiaries currently supply at least 50% of the market.

Nearly $4 million of the total $6.4 million spent for ***mass spectrometers*** in 1974 went for instruments combined with gas chromatographs. About two-thirds of the mass spectrometers now in use employ the sectorfield principle, but the trend is definitely toward quadrupole and dodecapole instruments. Also, digital displays are gaining importance. The combination of gas chromatograph and mass spectrometer with the quadrupole system probably has the greatest growth potential. An estimated 60% of this market is now supplied by Varian-Mat, a U.S. subsidiary manufacturing in Germany.

Purchases of ***nuclear magnetic resonance (NMR) spectrometers***, are expected to rise faster than the overall laboratory instrument market. Developments are in the direction of improved magnetic-error control, sample reduction, and modular construction. Computer manufacturers are important consumers in this sector.

Table 2.—Germany: Imports of selected laboratory instruments[1], 1972-1974

(in thousands of U.S. dollars)

	1972	1973	1974[2]
CRT oscilloscopies			
United States	3,375	6,136	5,346
Netherlands	4,261	4,590	3,036
United Kingdom	591	874	1,090
Japan	249	464	279
Other	494	949	1,293
Total	8,970	13,013	11,044
Laboratory centrifuges			
United States	567	847	555
United Kingdom	331	208	238
Japan	62	57	33
Switzerland	55	80	—
Other	106	122	189
Total	1,121	1,314	1,015
Electrical instruments for measuring and testing			
United States	8,373	13,474	14,165
Netherlands	3,506	6,001	6,508
Switzerland	3,159	4,492	5,044
United Kingdom	2,124	3,254	2,990
Others	9,122	11,890	13,156
Total	26,284	39,111	41,863
Light beam galvanometers			
United States	146	151	235
United Kingdom	79	47	67
France	30	48	—
Netherlands	29	33	—
Other	99	111	334
Total	383	390	636

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[1] Includes some instruments not used in laboratories.

[2] January through October only.

Source: Values based on data provided by the Federal Statistical Office, Wiesbaden, and trade estimates.

The U.S. share of the market is expected to increase from 45% in 1974 to 50% in 1979. The projected growth is based on the expanding demand for spectrometers with built-in electronics which are supplied primarily by U.S. firms.

The market for ***pH meters*** is essentially saturated. Laboratories are now buying digital reading and constant neutral point instruments and are anticipating readability up to 1/100th pH. German firms satisfy at least 60% of current demand.

Over 50% of the total market for ***densitometers*** consists of instrumentation for thin-layer and paper chromatography; the remainder is composed of scanners for electrophoresis. The importance of effluent

Table 3.—Germany, Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatogra	6.0	1.50	.60	3.90	9	2.7	.9	5.4
Liquid chromatographs	1.6	.56	.08	.96	3	1.2	.2	1.6
Mass spectrometers	6.4	2.24	.32	3.84	11	4.4	.6	6.0
NMR spectrometers	4.8	2.16	.96	1.68	8	4.0	.8	3.2
pH meters	1.6	.08	.24	1.28	2	.1	.2	1.77
Densitometers	3.2	1.60	.32	1.28	6	2.4	.6	3.0
Thermal analyzers	1.6	.72	.16	.72	3	1.1	.4	1.5
Automatic analyzers	14.0	7.00	2.10	4.90	22	11.0	2.2	8.8
Electron microscopes	5.0	.50	1.50	3.00	7	1.4	2.1	3.5
X-ray analyzer equipment	2.8	.84	.56	1.40	4	1.2	.6	2.2
Balances	6.0	.12	1.08	4.80	6	.3	.6	5.1
Oxyger analyzers	1.6	.24	.16	1.20	2	.3	.3	1.4
Spectrum analyzers	2.4	1.56	.60	.24	4	2.0	.8	1.2
Spectral photometers[1]	9.0	4.05	1.35	3.60	12	4.2	1.8	6.0
Laboratory centrifuges	10.0	.50	.50	9.00	12	1.2	1.2	9.6

[1] Includes only ultraviolet-visible photometers.

Source: Values based on German trade source estimates.

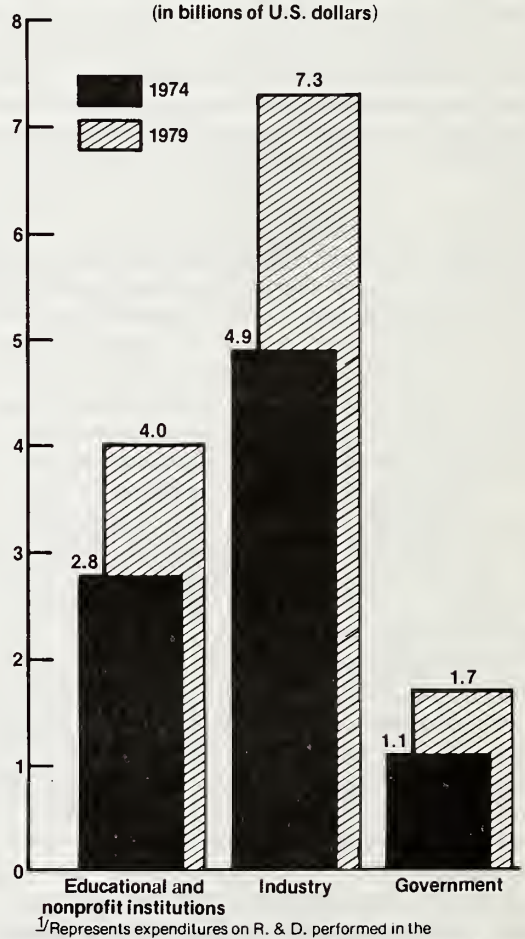
monitors is declining. The scheduled modernization of medical laboratories and research installations promises above-average growth in sales of densitometers for clinical use. U.S. firms supplied over 50% of the market in 1974 with sales of $1.6 million.

The 21% average annual growth rate projected for sales of *thermal analyzers* from 1974 to 1979 is based on increasing application in the main user industries—building materials, metallurgical research, and chemicals. Thermogravimetric analyzers will account for half the future sales, and substantial investment will be made in differential thermoanalyzers. Thermomechanical analyzers, including dilatometers, will play a less important role. U.S. firms and subsidiaries supply a large portion of the total thermal analyzer market, but such Japanese firms as Rigaku Denki are making significant efforts to increase their shares.

American technology dominates the *automatic analyzer* field. Technicon has patented the most important processes which function with continuous parallel channels. Competing instruments operate by means of charge-processes which are less desirable in practical applications. Demand is increasing for automatic analyzers using the centrifugal principle; this type is considered less susceptible to breakdown, more rugged, and more accurate. Sales of automatic analyzers are expected to rise rapidly with the increased interest in ecological protection and the planned improvements in medical research laboratories.

Electron microscopes include two classes of instruments: those for transmittal electron microscopy (TEM) and those for scanning of secondary electron beams (SEM). Sales of SEM (around $1.5 million in 1974) are projected to increase by 15% to 20% annually, while the market for TEM is expected to decline. The combination of SEM with energy dispersive X-ray

Figure 2. **Germany: R. & D. expenditures,**[1/] **1974 and 1979 (in billions of U.S. dollars)**



1/Represents expenditures on R. & D. performed in the designated sectors, regardless of the original source of the funds.

Source: 1974 data based on Bundesministerium fur Forschung und Technologie; 1979 data based on trade source estimates.

Table 4.—Germany: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
Employed by:	Physics	Chemistry	Other life		
Government	2,200	1,500	300	8,000	12,000
Industry	19,500	8,500	8,000	37,000	75,000
Educational and nonprofit institutions	4,000	4,000	2,000	15,000	23,000

Source: Data based on Bundesministerium fur Forschung und Technologie (Federal Department for Research and Technology) and trade source est

analyzers is opening up new fields of application. A combination of SEM and TEM is expected to prevail a few years hence, stimulating further growth in this market. Most of the TEM are supplied by German firms with their strongest competition coming from Japan. The U.S. share of the SEM market is expected to increase in the future due to the growing sophistication of American instruments.

The market for energy dispersive *X-ray analyzers* was estimated at $800,000 in 1974 and is expected to show exceptional growth, due partly to the combination possibilities. Most of these analyzers are supplied by U.S. firms. The 1974 market for X-ray spectrometers (wavelength-dispersive, single, and multichannel), including simultaneous and sequential analyzers, totaled $2 million. Knowledgeable sources believe that some 15 simultaneous and 50 to 60 sequential analyzers are bought annually in Germany. American influence is very strong in the simultaneous analyzers market, though most of these instruments are supplied by foreign subsidiaries of U.S. firms.

Illuminated scale *balances* are expected to be purchased in increasing numbers because of their ease of operation. Prospects will also be good for balances with extreme precision and scales with digital displays. These instruments are supplied by a relatively large number of companies, particularly German and Swiss firms. U.S. companies provide about 2% of the market, supplying mainly ultramicrobalances and microbalances.

Half of the *oxygen analyzers* purchased in Germany are made by Wissenschaftlich-Technische Werkstatten. U.S. firms, best known for oxygen analyzers with ionized electrodes, account for about 15% of this market.

Nearly all of the *spectrum analyzers* used in German laboratories are imported, with roughly 65% coming from the United States. Sales are expected to rise nearly 11% annually between 1974 and 1979. Current trends are toward increased interfacing with computers as well as toward cheaper, more versatile equipment.

Demand is rising most rapidly for single-beam and atomic absorption spectrophotometers. U.S. firms, including their European subsidiaries, supplied 40% to 50% of the double-beam, 20% to 25% of the atomic absorption, and 10% of the single-beam spectrophotometers purchased in 1974.

Ultracentrifuges, including analytical types, represented 40% of the *laboratory centrifuges* purchased in 1974 and are predicted to account for even larger percentages in the future. Beckman Instruments and its German subsidiary supply 70% to 80% of the ultracentrifuge market. Sales of high-speed centrifuges, including refrigerated types, reached $3 million in 1974 and are expected to rise while sales of the more conventional types decline.

Major Purchasers

The German Government intends to give priority to the following research programs through 1980:

Nuclear research, nuclear energy; e.g., development of improved nuclear power stations
Other energy research; e.g., liquefaction coal and establishment of remote heating plants
Space and aeronautics research
Technological R&D
Data processing and documentation
Marine research and technology
Transportation research; e.g., problems of suburban and metropolitan traffic.

In addition, medical research will be continued, especially at the universities, with particular emphasis given to studies of cancer and circulatory diseases. Environmental problems will receive increased attention over the next few years and funds are already allocated in federal and state budgets. Finally, defense research that is not classed as aeronautics or space studies will require more funds.

German R&D expenditures have grown considerably in past years, rising from $3.3 billion in 1969 to $8.8 billion in 1974. By 1979, the country's R&D budget should approach $13 billion, representing 8% average annual growth (see figure 2). The Government supplies just over 50% of all R&D funds and uses about 12% in its own laboratories. Almost 90% of the Government's investment is devoted to engineering and the physical and life sciences; 60% is allocated for nuclear research, and 20% goes for aeronautics and space programs.

Industry provides most of the remainder of the nation's research monies; it spent almost $5 million in 1974. Although a negligible source of funds,

Table 5.—Germany: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	400	$456	$600	$20.7	26.5
Educational and nonprofit institutions	3,000	1.592	2,101	88.2	113.6
Independent commercial laboratories	200	24	30	1.2	1.5
Medical organizations	4,800	681	913	22.7	30.0
Industry:					
Oil and gas extraction	10	4	5	.2	.3
Food products	800	62	80	2.4	3.0
Chemicals	1,800	645	851	32.1	41.8
Petroleum	20	25	33	1.2	1.6
Rubber and plastic products	110	48	63	2.3	3.0
Stone, clay, and glass	40	24	31	1.2	2.5
Primary metals	180	90	118	6.0	7.8
Fabricated metal products	100	20	30	.8	1.0
Transportation	60	190	255	1.8	6.2
Electrical	220	225	301	6.1	8.3
Other	900	92	119	27.5	35.1
Total	12,640	$4,178	$5,533	$217.7	$281.5

Source: Values based on German trade source estimates.

educational and nonprofit organizations nevertheless use almost one-third of the total. About 2% of the R&D budget goes for laboratory instruments.

Private foundations play a very small role in financing research in Germany. The most important, the Volkswagen-Foundation, created when its state-owned parent became a private corporation, uses the income from its assigned company shares to promote German research and science. The Stifterverband fur die Deutsche Wissenschaft (Foundation for German Science) collects and distributes funds for common-interest research projects, and gathers and publishes statistical data concerning business research.

German laboratories employed some 220,000 trained personnel in 1974 (see table 4). Between 2% and 3% of all German natural scientists have been enrolled in American universities as exchange students or for postgraduate work. The percentage among recent graduates is even higher.

Government laboratories. The Ministerium fur Forschung und Technologie (Department for Research and Technology) coordinates and finances all federal R&D efforts, although other government departments, especially the Defense Department, may make research funds available within the framework of their regular programs. Large R&D efforts may be promoted and financed jointly by the federal and state governments.

The Deutsche Forschungsgemeinschaft (German Research Society), jointly financed by the federal and state governments, plays a key role in all R&D activities. The Society disburses a sizable share ($203 million in 1973) of public research funds and acts as consultant and coordinator on the establishment of new universities and particularly in selections of technical-scientific equipment.

Germany has relatively few government-owned and -operated research institutes. Bundesgesundheitsamt (Federal Health Institute) and Physikalisch-Technische Bundesanstalt (Physical Technical Institute) are the major exceptions.

An estimated 400 laboratories are financed and controlled by the state and national governments. The 10 largest research centers each spend over $10 million annually and together account for 15% to 20% of the laboratory instruments purchased by this sector. Thirty laboratories are of medium-size with annual budgets from $4 million to $10 million. Altogether, government laboratories employed 12,000 scientists and expended $456 million in 1974 (see table 5). This sector is forecast to invest nearly $27 million annually in laboratory instruments by 1979.

Government test and evaluation laboratories are relatively unimportant in Germany. The leaders are the Bundesanstalt fur Materialprufung (Federal Institute for Materials Testing), which determines the acceptability of building materials, and the Physical-Technical Institute, which issues permits for highly volatile production processes. A quasi-private foundation, Warentest, examines consumer goods. A new organization, the Bundesumweltschutzamt (Federal Environmental Protection Institute) is being established and may grant contracts for certain environmental research projects.

The Technische Uberwachungsvereine (Technical

Supervision Institutes) act as private societies which by government request carry out public functions, including the regular control and inspection of vehicles, steam boilers, elevators, and other industrial equipment.

Nuclear research is the major concern of government laboratories—7 of the 10 large research centers are devoted to the study of the atom. The 4th Atomic Program calls for a total budget of $1.7 billion for 1975 and 1976. Nuclear technology accounts for 39% of the expenditures; reactor development, 25%; basic research, 23%; and fuel circulation, 13%.

An estimated $80 million will be spent annually over the next five years for research on aeronautics, space, and transportation systems. Studies of nonnuclear energy will require about $120 million between 1974 and 1979. The Government is also concerned with industrial safety, pure foods, and hygiene controls; in addition, supervision and control of air and water purity are being expanded.

The large research centers generally apply the following techniques: electron paramagnetic resonance, mass spectrometry, NMR, and radiometric, spectrometric, thermal, and X-ray analysis. Terminals connected to computing centers are rapidly becoming routine equipment, and the demand for minicomputers is growing. Nearly all the large laboratories have their own computers and all of the atomic research centers' equipment is automated. Many experiments are completely computer controlled; multichannel analyzers, in particular, are interfaced. Materials testing procedures are progressively being computerized. Government laboratories are currently buying:

Radiation measuring instruments
Semiconductive detectors
Spectrum analyzers
Oscilloscopes

Educational and nonprofit research laboratories.—University and independent nonprofit research laboratories are by far the most important consumers of laboratory instruments in Germany. Their purchases are expected to reach nearly $114 million in 1979. The 3,000 laboratories in this sector include 50 large establishments with annual operating budgets exceeding $4 million, which account for 10% of the sector's instrument purchases, and 200 medium-size concerns with budgets ranging from $2 million to $4 million annually. Altogether, these laboratories employ 25,000 scientists and engineers.

The most important institution in this category is the Max-Planck-Gesellshaft, which had a $220-million budget in 1973. This Society comprises 48 institutes—24 biological-medical, 15 physical-technological, and 9 in the humanities. Second in significance is the Fraunhofer-Gesellschaft with 14 institutes and a 1973 budget of $12 million.

The research conducted by this sector is all encompassing, although the natural sciences are emphasized. For example, the German Research Foundation granted 24% of its 1974 funds for mechanical engineering projects, 15% for biology, 14% for geoscience, 13% for chemistry, 12% for physics, and 6% for ecology. These grants are generally given for the purchase of the most advanced laboratory equipment. Some of the programs planned for the immediate future include R&D studies of activation analysis, radionuclide batteries, biosynthetic nutritional substances, environmental technology, polycyclic and chlorinated hydrocarbons, laser technology and holography, and metallurgical techniques.

The analytical methods predominantly used by this sector include chromatography, electron miscroscopy, mass spectrometry, polarimetry and spectropolarimetry, and radiometric, spectrometric, thermal, and X-ray methods. Computerized analysis is rapidly gaining in importance. Gas chromatographs, liquid chromatographs, amino acid analyzers, mass spectrometers, and NMR spectrometers, as well as the experimental devices of the large institutes, are being interfaced with computers.

Research programs undertaken by this sector and the planned expansion of the university system will require purchases of many instruments of the following types.

Liquid chromatographs
Ultraviolet, visible light, and infrared spectrometers
NMR spectrometers
Multichannel analyzers
Energy dispersive X-ray spectrometers
Goniometers
Oscilloscopes
Fluorescence spectrometers
Activation analysis equipment

Medical organizations.—Germany has a multitude of small medical laboratories but no large facilities. Approximately 100 medium-size organizations operate on $2 to $4-million annual budgets. Most of the employees in this sector are medical-technical assistants; 5,000 to 6,000 physicians and other scientists work either full or part time.

Clinical laboratories for routine medical examinations are expected to offer an excellent market for instruments as more attention is given to preventive medicine. There are clinical laboratories in each hospital plus some 200 independent operations serving private physicians. German efforts to improve health care include upgrading the quality of the equipment used by hospital clinics and promoting better diagnosis of outpatients.

The most important research laboratories are those associated with the leading universities and the Max-Planck-Institute. Two other prominent organizations should be mentioned: the Deutsches Krebsforschungszentrum (German Cancer Research Center) and the Pettenkofer and Robert Koch Institutes of the Federal Health Institutes. New research efforts being made in the fields of cancer, prenatal care, and circulatory diseases all require advanced laboratory equipment. Other areas of study include technical methods of preventive medicine, ceramic materials for bone replacement, therapy with neutrons, application of radiopharmaceuticals, radioimmunology, and tissue and cell culture.

German medical facilities are in the midst of a major expansion phase. At least eight university installations are involved in construction projects costing approximately $50 million each. Instruments will account for 2% to 4% of the total investment.

The foremost medical laboratories use analytical methods such as chromatography, colorimetry, electron microscopy, electrophoresis, and radiometric and spectrometric methods. Computers are used by some of the pure research laboratories and the larger clinics but not by the great mass of medical laboratories. Automatic analyzers, an important part of this market, are increasingly preferred for a variety of reasons: rising wages and the growing shortage of qualified personnel; the greater reliability and accuracy of automatic instruments; and the rising number of analyses required in medical practice. Demand is expected to be high over the next five years for the following instruments:

Autoanalyzers
Double-beam spectrophotometers
Densitometers
Liquid chromatographs
Single-beam photometers

Laboratories in the chemical industry. Production of chemicals is one of the largest and fastest growing industries in Germany. Production reached $22 billion in 1973, and output and investment are both predicted to rise 5% annually through 1979. This sector is particularly dependent on innovation and is by far the most important industrial user of laboratory instruments; purchases topped $32 million in 1974 and are expected to reach nearly $42 million in 1979. Three multinational giants—Bayer, BASF, and Hoechst—together account for 40% of the industry's R&D expenditures.

The industry as a whole employs about 2,000 technical engineers and more than 6,000 scientists. Approximately three-fourths are chemists; 15% to 20% are agriculturists, biologists, and pharmacists; and 5% to 10% are physicians and veterinarians.

Major laboratory projects in progress in 1975 included:

Development of new methods for synthesis of organic and inorganic compounds aimed at reducing environmental pollution
Purification of wastewaters of the chemical industry
Effect of feedstock selection on anmmonia production
High temperature pyrolysis processes
Phosphoric acid products (by wet process)
Carbonyl compounds synthesis
New technique of alkaline chloride electrolysis by mercury processes
Recycling of used, high-temperature teactor elements
Distribution of pesticides in the soilplant system
Coal liquefaction
Electrochemical synthesis of organic sulfones

The industry also does considerable work under Government contract. Present emphasis is on the development of environment-protecting technologies and materials.

Chromatography and spectrometric methods are increasingly important in chemical industry laboratories. Other widely applied techniques include mass spectrometry, polarimetry and spectropolarimetry, refractometry, turbidimetry and nephelometry, and electrometric and radiometric methods. Colorimetry, electron microscopy, and electrophoresis are used in pharmaceutical research.

Computerization in the laboratory is particularly important in the chemical industry. In clinical and materials evaluation laboratories closed computer systems are used; in pure research, because of the need for greater flexibility, gas and liquid chromatographs, amino acid analyzers, magnetic resonance and NMR spectrometers are usually interfaced with minicomputers. Computers are also being applied in the control and evaluation of experiments. Instruments that will be in demand over the next five years include the following:

Activation analysis equipment
Air sampling and analysis equipment
Gas chromatographs
Data processing systems for amino acid analyzers
Atomic absorption spectrophotometers
Fluorimeters
Energy dispersive X-ray analyzers
Oxygen analyzers
IR spectrophotometers
Fourier spectrometers
NMR and electron spin resonance spectrometers
Automatic analyzers
Ion-sensitive electrodes

Laboratories in the electrical and electronic equipment industry.—The German electrical and electronic equipment industry produces everything from power and high-voltage equipment to household appliances. World-renowned firms such as Siemens and AEG-Telefunken contribute to the success and continuing growth of the industry. Capital investment is so large that, despite the small percentage allocated for R&D equipment, this sector ranks second among industrial users of laboratory instruments. Each of the two firms and their affiliates spend close to $20 million annually for laboratory equipment, while some six or eight other companies invest $10 million to $20 million each. Altogether, these firms account for 40% to 50% of sector purchases. The industry as a whole employs almost 11,000 engineers and nearly 9,000 scientists in its R&D activities.

The research efforts of the industry are also supported by substantial public funds dedicated to improving technology, particularly in data processing and sophisticated electronics applications. Funds are currently devoted to R&D on the production of energy by means of new technologies, and the application of electronic equipment in the space program, in new short-distance traffic systems, and in new weapons systems. Specific research projects include:

Development of thick-film pastes
Production of single crystals
Production of diluted alloys by electrothermic preparation of molten salts
Supraconducting switches
Direct conversion of energy
Optical memories, based on holographic techniques
Optical telecommunication on fiberoptics
Supraconductors and cryotechnique
Controlled nuclear fusion
Gas-phase implantation of semiconductors
Data storage in photosensitive piezo-electric crystals

The analytic methods primarily used in the industry include electron microscopy; electron paramagnetic resonance (EPR); magnetic susceptibility; NMR; and electrometric, spectrometric, and X-ray methods. There is also a trend toward computerized instruments; electron spectrometers and oscilloscopes especially are being interfaced with computers. The ongoing and planned research in this sector will lead to greater demand in the next few years for the following items.

Pulse height analyzers
Multichannel analyzers
Scanning electron microscopes
Energy dispersive X-ray analyzers
Electron spectrometers
Image analyzers
Oscilloscopes

Laboratories in the primary metals industry.— The long-term prospects for Germany's primary metals industries are excellent; production is expected to increase by more than 5% annually. Capital investment will grow at a similar rate and include substantial expenditures for laboratory equipment. Each of the 10 largest firms spend between $5 million and $10 million annually to maintain their laboratories; together they account for 60% to 70% of the sector's instrument purchases. The steel industry alone employs 900 scientists and 700 graduate engineers.

The average laboratory in the industry is highly instrument-intensive and readily purchases sophisticated instruments. Production processes normally require continuous and extremely accurate analyses of samples. The major companies also are engaged in strenuous R&D efforts to improve metallurgical technology. Some of the specific studies currently underway are:

Thermomechanical treatment of copper-based alloys
Removal of chromates from waste alkaline-liquors from the pickling liquors of high-alloy steels
Recovery of slags from aluminum metallurgy
Corrosion behavior of austenitic steels
Recrystallization studies in metallic materials
Studies of mold metal interaction
Surface investigations with respect to passivity and frictions
Strengthening mechanisms in steel alloys
Development of continuous steelmaking processes
Studies to increase the gas penetration in sinter layers

The most important techniques used in the industry are spectrometry and thermal and X-ray methods. Some of the more standard methods applied include electron microscopy, EPR, magnetic susceptibility, and NMR. The trend is definitely toward more intensive application of data processing equipment. Demand is growing for minicomputers; interfacing is becoming common practice, although complete computer systems are preferred for some operations, especially those that involve NMR spectrometers.

Purchases of the following instruments are expected to be substantial.

Activation analysis equipment
Air sampling and analysis equipment
Gas analyzers for emission and immission
Particle size analyzers
Scanning electron microscopes
Energy dispersive X-ray analyzers
Electron spectrometers
Light emission spectrometers
X-ray spectrometers
X-ray diffractometers
NMR and electron spin resonance spectometers

Independent commercial laboratories.— There are only some 200 commercial laboratories in Germany, none of them with annual expenditures exceeding $400,000. Most of the 300 to 500 scientists working in this sector are chemists.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Germany is available on a continuing basis from:

Country Marketing Manager-Germany
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Germany," DIB 75-08-503, February 1975.

The most important enterprises, the independent food chemistry laboratories, typically test food samples or study harmful substances in food for companies that may be engaged in disputes with official health agencies. They may also supervise and control production for small food manufacturers who cannot afford their own laboratories. In addition, a few research laboratories do contract research on a commercial basis. In many cases, these firms are independent research departments of industrial establishments.

Computers are not generally used in these small laboratories, although food chemists do otherwise attempt to keep pace with the methods of the official agencies.

The best sales opportunities for U.S. instrument manufacturers include:

- Gas chromatographs
- Spectrophotometers
- Densitometers
- Photometers
- Microscopes

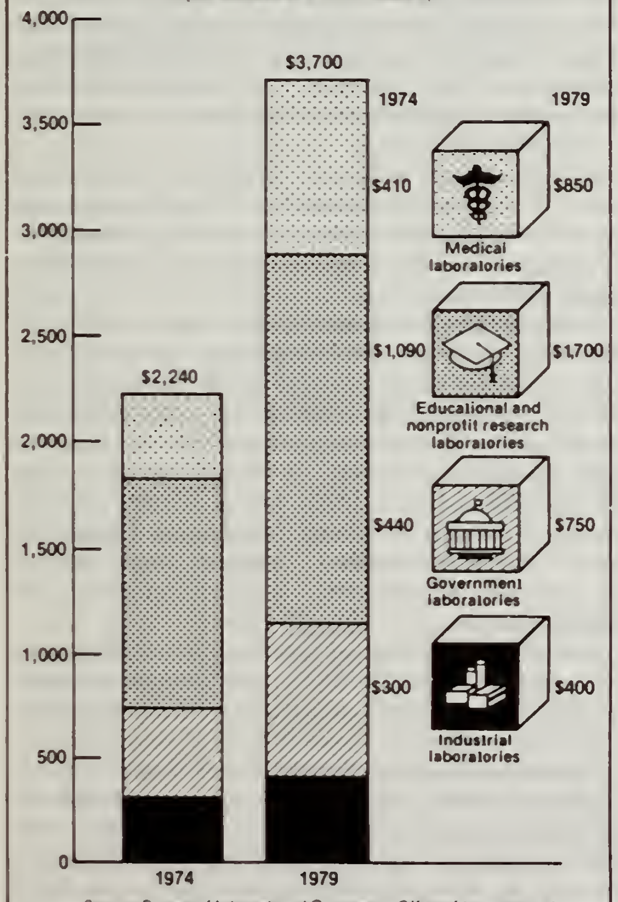
Trade and Technical Regulations

Tariffs range from 5% to 13% on laboratory instruments, but instruments imported for research and development are exempt from customs duties. All electrical equipment has to comply with VDE (Association of German Electrical Engineers) regulations, which are published by VDE Verlag GmbH., 1 Berlin 12, Bismarckstr. 33. German standards are issued by the Deutscher Normenausschuss, the German Committee for Standards. Detailed information can be obtained from Beuth-Vertrieb GmbH., 1 Berlin 30, Burggrafenstr. 7. Information on current standards can be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

Hong Kong

Hong Kong laboratories have a continuing need for medium- and low-technology instruments and are just beginning to to acquire the more sophisticated items. The laboratory instrument market rose an average 36% annually between 1972 and 1974, when government agencies were investing heavily, but is not expected to maintain this very rapid expansion (see table 1). Sales increased 11.1% in 1975 to $2.5 million,[1] and an average annual growth of nearly 11% is predicted for the entire 1974-79 period. Hong Kong end users are forecast to pay nearly $3.7 million for laboratory instruments in 1979.

Figure 1. Hong Kong: The market for laboratory instruments 1974 and projected 1979 (in thousands of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report; values based on Hong Kong trade source estimates

Almost half the laboratory instruments purchased in Hong Kong are used by educational and nonprofit research organizations (see figure 1). Growing demand for high-technology equipment for basic research and more conventional instruments for training and applied research is expected to boost consumption by this sector from nearly $1.1 million in 1974 to more than $1.7 million in 1979.

A major construction program is underway in the medical sector, and several new laboratories will be outfitted between 1974 and 1984. Laboratory instrument purchases for this sector are predicted to increase an average 16% annually, rising from over $400,000 in 1974 to $850,000 in 1979. The Government is increasing expenditures for pollution and drug control and is expanding its testing capability. Instruments for new and replacement uses for Government-operated facilities are projected to cost $750,000 a year by 1979.

Hong Kong manufacturers tend to rely on labor-intensive production methods and have shown little interest in research and development (R&D) and only slight concern for quality control. The Government is urging industry to improve production methods and add more sophisticated product lines. Manufacturers are expected to increase their investments in laboratory equipment, but their instrument purchases are forecast to grow more slowly than the overall market during the 1974-79 period. Sales to industry are projected to approach $400,000 in 1979.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = HK$ 5.96 (1972), HK$ 5.14 (1973), and HK$ 5.09 (1974 and subsequent years).

Table 1.—Hong Kong: Size of market for laboratory instruments, 1972, 1974, and estimated 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	.02	.03	.04
Imports	1.42	3.16	3.50
Exports	.27	.95	1.05
Market size[1]	1.17	2,24	2,49

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[1] Market size equals production plus imports minus exports.
Source: Values based on Hong Kong trade source estimates

Competitive Environment

Virtually all of the laboratory instruments used in Hong Kong are manufactured abroad. The 1974 import market was estimated at $3.2 million, representing an average annual increase of nearly 50% above the 1972 total. Conservative projections of a yearly growth of over 10.6% place 1979 imports at over $5 million.

A substantial number of imported laboratory instruments are reexported to countries such as The Peoples Republic of China, North Vietnam, and North Korea. The Hong Kong economy is based largely on foreign trade, and the island also serves as a regional distribution center for a number of firms. Laboratory instrument exports jumped dramatically from $270,000 in 1972 to $960,000 in 1973, or from 19% to 38% of imports. Trade sources predict that 30% of the instruments imported during the 1974-79 period will be resold outside Hong Kong and forecast a $1.6 million export market in 1979.

The share of the laboratory instrument import market held by U.S. manufacturers has recently surged, rising from 18% in 1972 to 33% in 1974 and 39% in 1975. U.S.-made products now lead the market (see table 2). A major factor in this sudden advance was the dollar devaluation, which enabled American firms to match Japanese and European prices. Some laboratory instruments are purchased from third-country subsidiaries of U.S. firms. The share of Hong Kong's import market supplied from the United States is expected to decline slightly, reaching about 36% by 1979.

Hong Kong consumers praise the high quality and technical advantages found in U.S. laboratory instruments and are particularly impressed with the durability of these products. American manufacturers are considered world leaders in electronics, laser technology, and environmental control equipment. The policy of some suppliers to train the purchaser's personnel in repair and use of equipment has been greatly appreciated.

All the major U.S. manufacturers of laboratory instruments are represented in the Hong Kong market. Beckman Instruments, Inc. supplies a wide range of instruments and is best known for pH meters, infrared (IR) spectrometers, ultracentrifuges, ratio fluorometers, nitrogen oxide analyzers, viscometers, spectrophotometers, and water meters. Perkin-Elmer Corp., either directly from the United States or through its joint venture, Hitachi-Perkin-Elmer in Japan, provides ultraviolet (UV), IR, atomic absorption (AA), and visible spectrophotometers; gas chromatographs; and mass and nuclear magnetic resonance (NMR) spectrometers. Varian Associates is another leading supplier of gas chromatographs and AA and UV spectrophotometers.

In the electronics field, Hewlett-Packard Co. dominates with its line of computers, oscillators, modulators, network analyzers, frequency counters, and distortion analyzers. Tektronix, Inc. is a strong contender, particularly in advanced and sensitive oscilloscopes.

Technicon Co., Inc. leads the automatic analyzer field; its products are found in every installation in Hong Kong that uses this kind of instrument. Tracer Laboratories supply liquid scintillation and gamma counters. Baird-Atomic, Inc. has sold grating spectrographs in the Colony; Sargent supplies polarographs. John Fluke Manufacturing Company, Inc. is respected among differential voltmeter and oscilloscope users. Scientific Industries, Inc. supplies voltage, resistance, and capitance transfer systems, and Keithley Instruments sells milli-microvoltmeters. Although U.S. manufacturers do not generally market balances in Hong Kong, Kern Instruments, Inc., and Ohaus Scale Corp. have sold their goods there. Gamma Scientific, Inc. supplies microdensitometers, photometers, light intensity measurement apparatus, and spectroradiometers.

U.S. firms such as Spectra-Physics are particularly strong in the laser system market. Scott is famous in Hong Kong for fabric-and yarn-strength testers, while Corning and its joint-venture company, Corning EEL, supply pH meters.

Japanese manufacturers were the major suppliers of laboratory instruments to Hong Kong users until 1974. The success of such firms as JEOL, Shimazu, and Hitachi was based largely on low price and proximity. As U.S. prices became more competitive, the Japanese share of the import market declined, dropping from 38% in 1972 to 27% in 1974. Among the laboratory instruments recently purchased from Japanese companies are microscopes, ancillary equipment for electron microscopes, and automatic recording equipment for chromatographs.

U.K. firms held 24% of the Hong Kong laboratory instrument market in 1972. All government and publicly supported organizations have been encouraged and sometimes required to buy only from U.K. companies.

Purchases have often been processed through Crown Agents in London, who naturally favor local suppliers. British manufacturers began to lose sales in the early 1970's because of long delivery times, and by 1974 their share of the laboratory instrument import market had fallen to 19%. Even government agencies now seek other supply sources. Nonetheless, some British firms are expected to retain their strong market positions. Joyce, Loebl continues to supply densitometers, and Measuring and Scientific Equipment Ltd. is well known for centrifuges. U.K. producers of electronics equipment rank second only to U.S. manufacturers; for example, Marconi has a long history in the market and is expected to continue as a major source of power supplies, oscilloscopes, transfer function analyzers, potentiometers, galvanometers, dynamometers, phasemeters, and waveguides.

Hong Kong end users respect the high quality of German laboratory instruments. German-built NMR spectrometers, automatic diffractometers, and electron microscopes are considered technically superior. Leitz and Sartorius are among the major suppliers of balances; Reichert is famous for microtome equipment. These and other German manufacturers together consistently supply about 8% of imports.

Other leading third-country suppliers include Mettler of Switzerland (balances) and LKB of Sweden (microtome equipment). Philips of the Netherlands and its U.K. subsidiary, Pye Unicam, supply electron microscopes, automatic diffractometers, NMR spectrometers, spectrophotometers, and chromatographs.

Domestic production of laboratory instruments is very small and not expected to grow significantly in the near future. Output totaled $25,000 in 1972, rose to about $30,000 in 1974, and is projected at approximately $40,000 in 1979. Hong Kong's two major universities both have shops that fabricate simple instruments, and a few laboratories build some of their own equipment. In addition, several dealers assemble balances and other simple instruments from imported parts.

Selected instrument markets.—A survey analyzing the sales potential for 10 products (see table 3) was conducted for the Office of International Marketing, Bureau of International Commerce. The 1974-79 market for these instruments was reviewed in depth. According to this survey, purchases of ***gas chromatographs*** should rise from $80,000 in 1974 to $290,000 in 1979. A number of laboratories, including those in pharmaceutical and petrochemical plants, plan to acquire these instruments in the near future. U.S. firms supplied 90% of this equipment in 1974, but their share is forecast to decline to about 70% by 1979. U.K. and Japanese suppliers are expected to gain.

Few ***liquid chromatographs*** were sold in Hong Kong in 1974, and end users appear to be hesitant about adopting this technique. The $40,000 market anticipated for 1979 is likely to be supplied mainly by U.S. manufacturers.

Only a few ***NMR*** and ***mass spectrometers*** will be purchased during the 1974-79 period. Japanese and American firms share this market almost equally. U.S. instruments are preferred for high technology, and Japanese products are less expensive.

Annual sales of ***pH meters*** are expected to double between 1974 and 1979 as laboratories expand and more applications of these instruments are found. The U.S. share is forecast to decline from 40% in 1974 to 30% in 1979, primarily as a result of Japanese firms' ability to offer better prices, faster delivery, and greater availability.

Table 2.— Hong Kong: Imports of selected laboratory instruments[1] 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[2]
Nonmechanical instruments for physical or chemical analysis			
United States	111	241	284
United Kingdom	297	526	409
Japan	97	206	75
Germany	6	76	44
Other	51	47	136
Total	562	1,096	948
Compound optical microscopes			
United States	47	157	463
Japan	161	164	331
Germany	47	94	105
China	33	71	49
Other	7	57	109
Total	298	710	1,019
Electrical measuring, control apparatus			
United States	545	961	1,341
Japan	1,591	2,042	1,716
United Kingdom	387	438	352
Germany	189	244	278
Other	302	987	283
Total	3,014	4,672	3,970

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[1] Values given include instruments for other than laboratory use.

[2] January through August 1974.

Source: Data based on *Hong Kong Trade Statistics*, Census & Statistics Department, Hong Kong.

Photovolt Corporation is the major U.S. supplier of ***densitometers***. Most of these instruments come from Joyce, Loebl of the United Kingdom and are sold as part of a system. Sales, primarily to hospitals and medical laboratories, are predicted to increase 25% annually during the 5-year period.

Most of the projected growth in the ***thermal analyzer*** market will be due to higher unit costs rather than increases in the number of instruments sold. The trend toward more sophisticated instruments favors U.S. manufacturers, whose sales are forecast to increase from $8,000 to $18,000 a year.

Consumption of ***automatic analyzers*** is increasing very rapidly as a result of their growing popularity in laboratories handling a large number of routine tests. U.S. suppliers, particularly Technicon, supply virtually all of the market, and no change is expected, in view of the large technological lead held by U.S. suppliers. Hong Kong also offers a market for old and outdated models.

Sales of ***balances*** are expected to continue to increase about 4.6% annually in view of the general increase in the market for laboratory instruments, upgrading to more sophisticated models, and replacement of old balances. The upgrading should increase the U.S. share from 20% in 1974 to 25% in 1979.

Table 3.—Hong Kong: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total	U.S.	Total	U.S.
Gas chromatographs	80	72	290	203
Liquid chromatographs	—	—	40	32
Mass spectrometers	—	—	80	40
NMR spectrometers	—	—	6	3
pH meters	30	12	60	18
Densitometers	10	1	30	3
Thermal analyzers	20	8	35	18
Automatic analyzers	100	100	300	300
Balances	80	16	100	25
Oxygen analyzers	20	16	40	36

Source: Values based on Hong Kong trade source estimates.

Demand for *oxygen analyzers* is predicted to grow from $20,000 in 1974 to $40,000 in 1979, a 15% average annual increase. The already high U.S. share is forecast to grow to 90% of the market by 1979.

Major Purchasers

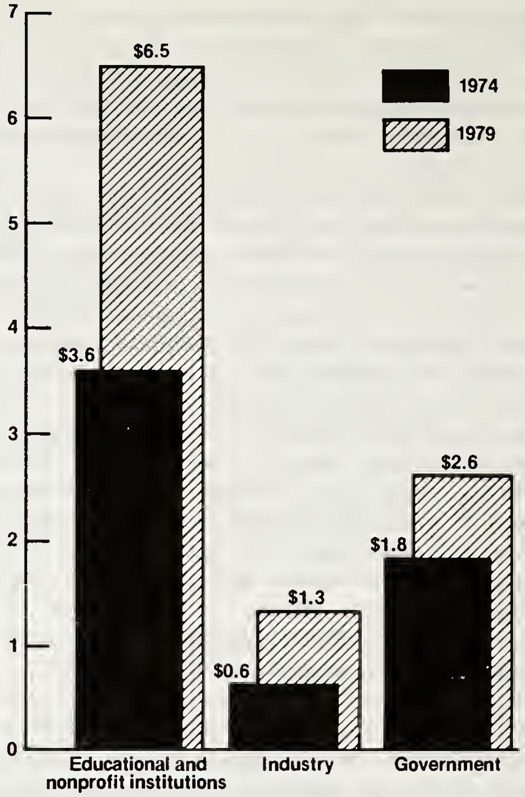
Approximately $6 million was spent for R&D in Hong Kong in 1974 with 80% to 85% devoted to the physical, engineering, and life sciences. R&D expenditures are projected to increase an average of nearly 11% annually, reaching over $10 million in 1979. Trade sources estimate that 55% to 75% of these funds is allocated for laboratory expenditures. The major areas of research during the 1974-79 period will be in the fields of chemistry and medicine, physics, pollution, electronics, drugs, and food technology.

The Government is the major source of R&D monies and supplied 80% in 1974 and is projected to provide 65% in 1979. Industry and educational and nonprofit institutions each provided about 10% in 1974. As industry achieves greater sophistication, its contribution to R&D will grow; an increase from $600,000 in 1974 to $1.6 million in 1979 has been forecast.

All basic research and much of applied research is conducted in the universities. Educational and nonprofit institutions spent $3.6 million, or 60% of the total outlay for R&D, in 1974 and are expected to account for a slightly larger portion of R&D expenditures in 1979 (see figure 2). Government laboratories used approximately 30% of the R&D funds in 1974 and are forecast to spend $2.6 million in 1979. The fastest growth, almost 17% annually, is anticipated in industrial R&D expenditures.

Nearly 2,300 professionals were employed in the physical and life sciences in Hong Kong in 1974 (see table 4). Most of the 177 scientists have studied abroad, primarily in the United Kingdom or the United States. About 90% of the 400 engineers and 30% to 40% of the technicians were trained overseas.

Figure 2. Hong Kong: R&D expenditures,[1/] 1974 and 1979 (in millions of U.S. dollars)



[1/] Represents expenditures on R&D performed in the designated sectors, regardless of the original source of the funds.

Source: Values based on Hong Kong trade source estimates.

Government laboratories.—The Hong Kong Government operates about 20 laboratories (see table 5) with nearly 900 professional employees. Laboratory expenditures reached $620,000, including $440,000 for instruments in 1974, and are projected at $782,000 in 1979. Most of the government laboratories are under the jurisdictions of the Department of Medicine and Health, Public Works, Labor and Mines, and Agriculture and Fisheries.

The total budget for the Medical and Health Department grew from over $57 million in FY 1974[2] to more than $61 million in FY 1975 and included funds to support many of Hong Kong's 60 medical laboratories. The Department operates several major hospitals, the Institute of Pathology, and the Government Laboratory. Nearly $140 million has been budgeted for the 1974-84 period for new medical facilities, including hospitals at Shatin and Tuen Mun, a medical school in the Chinese University, a dental school, and a nurses' training center. Also in the detailed planning stage are a Kowloon East Polyclinic, a new mental hospital at Lai Chi Kok, Stage II of the Kwai Chung Jockey Club Polyclinic, additions to the

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[2] Fiscal year runs from April 1 to March 31.

Table 4.—Hong Kong: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
	Physics	Chemistry	Other life		
Employed by:					
Government	0	15	35	138	700
Industry	5	5	9	152	750
Educational and other nonprofit institutions	36	34	38	107	250

Source: Estimates based on Scientific Directory of Hong Kong and Hong Kong trade source estimates.

Table 5.—Hong Kong: Laboratory expenditures[1] by major end users, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	20	620	782	440	750
Educational and nonprofit institutions	5	2,000	2,900	1,090	1,715
Independent commercial laboratories	25	2	4	1	2
Medical organizations	60	1,000	2,800	408	850
Industry:					
Electronics	10	150	200	90	150
Food products	4	9	10	6	8
Chemicals	6	12	16	5	15
Petroleum	4	6	11	3	5
Rubber and plastic products	3	4	6	2	5
Textiles	15	225	300	78	90
Primary metals	2	2	4	1	2
Fabricated metal products	5	5	5	3	3
Other	15	225	300	115	120
Total	174	4,260	7,340	2,242	3,715

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[1] Laboratory expenditures include funds spent on building construction, capital equipment and laboratory instruments and excludes salaries and recurring expenditures.

Source: Values based on Hong Kong trade source estimates.

Castle Peak hospital, a specialist clinic on Hong Kong Island East, standard clinics at Lam Tin, Lei Yue Mun, and Ngau Tau Kok, and an Arran Street Eye Clinic.

The Institute of Pathology maintains public health laboratories at Sai Ying Pun Polyclinic and Kowloon Hospital and a virological laboratory at Queen Mary Hospital. Other clinical laboratories are located at Queen Elizabeth, Lai Chi Kok, and Castle Peak Hospitals. About 14,000 examinations in both curative and preventive medicine are undertaken by the Institute annually, including many tests for privately funded hospitals. Demand for services is increasing in the fields of histopathology, chemical pathology, nematology, serology, and virology.

The Government Laboratory employs about 100 people, including 20 with professional backgrounds and 45 technicians. The annual budget varies from $60,000 to $80,000. One of the Laboratory's major functions is forensic testing and research, which is administratively assigned to the Medical and Health Department. The Laboratory operates a large facility inside the Police Criminal Investigation Department and a new, expanded laboratory at Kowloon. About 40,000 items are examined each year; the testing is mostly in the areas of narcotics, arson, and toxicology. The crime rate is rising, and expenditures for the forensic laboratories are mounting accordingly. About $200,000 is budgeted for a new laboratory at Kowloon. A program to study methadone maintenance for drug addicts cost $120,000 in FY 1975 and treated 30,000 addicts. Urine samples are now tested for morphine content by thin-layer chromatography, but scintillation counters will be needed in the near future.

The Government Laboratory also tests food and pharmaceuticals for the Customs and Excise Department, Food Control, and Department of Urban Services' Hygiene Division. Locally produced and imported foods are examined for bacteriological content and chemical analysis to determine the presence of restricted or prohibited food additives or pesticides. The passage of a new regulation governing pharmaceutical drugs and poisons in 1975 has increased the workload, and more equipment and personnel are being added.

Test and evaluation services are also provided for the Fire Services and the Department of Labor and Mines.

The Government Laboratory tests the physical properties of industrial materials and determines the flashpoint for dangerous substances. Some of the methods used by the Laboratory for its many tasks are gas chromatography, colorimetry, electrometric analysis, electrophoresis, particle size analysis, polarimetry, refractometry, saccharimetry, X-ray methods, turbidimetry and nephelometry, and AA, UV, and IR spectrometry.

The Water Quality Unit of the Public Works Department controls water treatment and is continually seeking better and more economical methods for maintaining quality. The analytical and advisory services of the Unit are used in the planning and commissioning of new water supply projects by other government departments, commercial and industrial firms, and the general public. The Unit operates two main and two subsidiary laboratories for testing samples and miscellaneous materials connected with the water supply. Of the 35,000 samples examined each year, 64% are tested for chemicals, 20% for bacteria, and 16% for biological matter. The laboratories use thin-layer chromatography, colorimetry, and turbidimetry; a gas chromatograph and a spectrophotometer were purchased in 1975. A seawater desalinization plant, capable of handling 40 million gallons per day and scheduled for completion in late 1975, will require new purchases of laboratory equipment.

The Public Works Department also operates two Materials Testing Laboratories serving the Government and the public, and two laboratories located at government quarries that test output. Altogether, these laboratories conduct about 80,000 tests annually, nearly 9,000 for private firms; concrete and soil tests are most common. Equipment purchases average $2,000 per year, but the addition of a concrete pipe strength tester pushed 1974 expenditures to nearly $20,000, and the 1975 budget included almost $60,000 for purchases of a hydrostatic tester. Nearly $115,000 has been budgeted for future special expenditures for testing equipment. The main laboratory at North Point recently installed an Avery universal tester to handle heavier samples of such materials as concrete and asphalt. The laboratory also uses grinder, hardness, viscosity, elongation, and flakiness testers; spectrometers are used for cement and lime analysis. The Materials Testing Laboratories use compression and rubber stress testers, sieves, incubators, penetrometers, balances, centrifuges, pH meters, and ductility and permeability testers.

The Industrial Health Division of the Labor and Mines Department operates an Industrial Hygiene Laboratory. The Air Pollution Control Unit of the Division also maintains a laboratory that uses gas chromatography and calorimetric balance methods; sulfur and particulate matter are monitored at 36 stations. Laboratory expenditures for the Air Pollution Control Unit reached $197,000 in FY 1975, and $490,000 has been requested for FY 1976. In 1975, the Hong Kong Government engaged a U.K. company, Environment Resources, to act as consultant on a project to design and establish an air pollution control monitoring system. Cost estimates for the entire project range from $1 million to $2.4 million.

The research budget of the Agriculture and Fisheries Department has been growing—for example, research costs for Fisheries rose from $57,000 in FY 1974 to $67,000 in FY 1975. Special expenditures for field and laboratory equipment amounted to over $18,000 in FY 1975 and included $5,300 for a biological safety cabinet and nearly $6,000 for an incubator. The Castle Peak Veterinary Laboratory uses colorimetry, electrophoresis, and turbidimetry and nephelometry. The Chemistry Section of the Crop Husbandry and Health Division maintains a laboratory at Tai Lung Farm; instruments employed include torsion balances, colorimeters, electronic balances, flame photometers, and voltmeters.

Government laboratories do not use computers; the research workload does not warrant computerization now or in the immediate future. Instruments that are expected to be in demand over the next 5 years include the following:

Gas chromatographs
Automatic analyzers
Scintillation counters
Sulfur dioxide monitors
Smoke monitors
Hydrocarbon analyzers
Carbon monoxide monitors
Ozone monitors
Nitrogen oxide monitors
Meteorological instruments

Educational and nonprofit research laboratories.— Hong Kong's educational and nonprofit research laboratory sector consists of five organizations— Hong Kong University , the Chinese University of Hong Kong, the Hong Kong Polytechnic, the Federation of Hong Kong Industries, and the Hong Kong Productivity Center. The sector spent $1.1 million for laboratory instruments in 1974 and employed more than 100 scientists.

Government budget estimates show that recurrent and capital grants to the two universities and the polytechnic grew from more than $20 million in FY 1973 to over $32 million in FY 1975. Future expansion plans include the second phase of the Chinese University Science Center, expansion and improvements to the Morrison Hill Technical Institute, and new technical institutes at Cheung Sha Wan, Kwun Tong, and San Po Kong. Construction of a new campus for Hong Kong Polytechnic is already underway.

Hong Kong Polytechnic has several divisions that require laboratory instruments. The Department of Mathematics and Science teaches chemistry, mathematics, physics, and dentistry. For chemical analysis, the Department uses colorimeters; direct-reading, single-beam photometers; double-beam spectrophotometers; atomic absorption flame photometers; and fluorometers. In the Physics Section, there is simple teaching-grade spectrometry equipment, some Geiger counters, a pulse height analyzer, and other simple electric testers. The Department of Electrical Engineering has a laboratory equipped with a 12-channel UV recorder for transit analysis, an analog computer, a minicomputer, oscilloscopes, power supplies, and other testing equipment; an AC/DC voltage and current calibrator and a high-quality digital multimeter were recently added. The computers are used to teach electronic and electrical methods, not for laboratory automation.

The Department of Civil and Structural Engineering at the Polytechnic is now planning a new laboratory, which will include a full range of materials testing equipment. The Department of Production and Industrial Engineering has teaching laboratories for metrology, metallurgy, plastic technology, industrial engineering, and electroplating. The Department of Textile Industries has a fully equipped laboratory for textile testing.

Each of the many science and engineering departments of Hong Kong University has its own laboratory instruments. The Chemistry Department has an annual budget of $65,000 for capital items plus $39,000 for spares, parts, and general laboratory expenses. The Department has an NMR and a mass spectrometer, an X-ray generator, and UV-visible, AA, and IR spectrophotometers; a Raman spectrograph was purchased recently. There are no plans for computerization beyond those included in the equipment on hand.

Laboratory expenditures for the Physics Department of Hong Kong University vary widely from year to year. Nearly $20,000 was spent for capital goods and $30,000 on other laboratory items in 1974; in some years, as much as $120,000 has been invested in laboratory instruments. The Department now has a milli-microvoltmeter, oscilloscopes, spectrograph, monochromator, electromagnet, pulse generator, pulsed laser, and integrating digital voltmeters. The Biochemistry Department, which spends between $10,000 and $20,000 on laboratory equipment each year, presently owns a gas chromatograph and AA and UV spectrophotometers. The Microbiology Department has an annual budget of about $10,000 for laboratory instruments. Equipment currently installed includes balances, centrifuges, a colorimeter, a demineralizer, incubators, immunoelectrophoresis apparatus, microscopes, pH meters, spectrophotometers, and water baths.

The Department of Mechanical Engineering spends about $40,000 annually for testing and laboratory equipment. They now have an automatic counter, digital voltmeters, and various materials testing equipment including a 100,000-kilo universal tester. In the future, the Department will concentrate on vibration-producing and strain gage equipment. Purchase of a 50-ton universal testing machine costing about $50,000 is planned.

The Electrical Engineering Department of Hong Kong University has laboratories for communications, computer, power, electron physics and measurements, and electronics. Expenditures for laboratory equipment and instruments for these combined facilities totaled $50,000 in 1975; about $20,000 was spent for components and parts. The Department of Pathology, located in the Queen Mary Hospital compound, performs ongoing clinical analyses and basic research. The Department's equipment includes a thermocirculator, a viscometer, a gas chromatograph, an ultracentrifuge, a fluorometer, UV-visible and AA spectrophotometers, automatic analyzers, electrophoresis apparatus, liquid scintillation counters, a gamma counter, and balances.

The science departments of the Chinese University closely parallel those of Hong Kong University. The Chemistry Department uses AA, UV-visible, near-infrared, and IR spectrophotometry, NMR, X-ray analysis, and gas chromatography. The Physics Department is emphasizing research on lasers and optical physics. Equipment includes electronics test items such as oscilloscopes, voltmeters, ammeters, microvoltmeters, a viscous-elastic spectrometer, microscopes, microphotometers, a nuclear detection system, and a neutron generator. The expanding Biochemistry, Biology, Chemistry, Physics, and Electronics Departments all plan major instrument purchases in the next 5 years.

Hong Kong's rapid change from a trading to a manufacturing center led to the establishment of the Federation of Hong Kong Industries in 1960. The Federation now has 900 member firms and provides technical services to industry while serving as a bridge between the Government and the manufacturing sector.

One of the primary activities of the Federation is testing locally made products to ensure that they meet the overseas buyer's technical requirements and relevant international standards. The Federation acts as agent for foreign consumer inspection authorities such as the British Standards Institution, Federation of Swiss Watch Manufacturers, Intercontrol, International Wool Secretariat, Japan Knitting Inspection Institute Foundation, and the International Organization of Standardization.

Nearly $30,000 was spent for instruments for the Federation's laboratory in 1974, and expenditures of $35,000 are forecast for 1978. Each year, close to $7,000 is allocated for parts and materials. The laboratory does chemical and electrical testing and evaluates electronic products, food, footwear, packaging materials and packages, textiles, toys, and watches. A microbiological laboratory and a new food laboratory will be added in the near future.

The Hong Kong Productivity Center operates a small laboratory in conjunction with its facilities for training and experimentation in metal plating and other metalworking. Future laboratory expenditures are expected to be mainly for replacements.

Demand for the following items is expected to be high over the next 5 years in the educational and nonprofit research laboratory sector.

- Gas chromatographs
- NMR, mass, IR, and UV spectrographs
- Spectrophotometers
- X-ray fluorescence spectrometers
- X-ray generators
- X-ray diffraction cameras
- X-ray absorptionmeters
- Scintillation counters
- Differential thermal analyzers
- Signal generator automatic analyzers
- Amino acid analyzers
- Nitrogen oxide analyzers
- Pulse-height analyzers
- Transient analyzers
- Spectrum analyzers
- pH meters
- Balances
- Microbalances
- Double-beam and dual-trace oscilloscopes
- Microscopes
- Centrifuges
- Vacuum equipment
- Incubators
- Potentiometers
- Automatic diffractometer
- High voltage electrophoresis apparatus

Laboratories in the electronics industry.— Hong Kong's electronics industry consists of approximately 350 firms with a total of 55,000 employees. The largest firms are foreign subsidiaries or joint ventures that are generally engaged in producing components for the parent companies. In 1973, the 64 factories backed by American or Japanese capital employed 55% of the industry's workers.

In the first 6 months of 1974, electronics exports reached $300 million. Transistor radios accounted for about 48% of the electronics exports; memory cores, planes, arrays, and stacks accounted for 16%, transistors for 14%, and electronic calculators for 4%.

Production of electronic goods had been growing 20% to 30% annually until 1974 when output increased only 10%. Factory managers are becoming more conscious of the need for product development and improvement, and some feel that survival depends on upgrading and diversifying product lines. This shift in attitude is expected to lead to greater expenditures for R&D. The sector is already Hong Kong's largest industrial consumer of laboratory instruments, which are used primarily for quality control and calibrations.

The industry's large laboratories, each with more than 5 scientists, are found at Fairchild Semiconductor, Ampex Ferrotec, and Gilman and Company. Fairchild spends from $4,000 to $10,000 a year for instruments such as transfer systems, frequency counters, and voltmeters used in the calibration of semiconductors. Ampex builds memory devices and needs equipment to test timing. Gilman and Company, agents for General Radio and Tektronix, have a service laboratory. Most of the instruments used in the industry are various types of oscilloscopes and noise generators to test frequency distortion and to locate various component faults.

Several trends within the electronics industry are expected to increase demand for laboratory instruments. Companies are gradually entering into vertical integration in the production of semiconductors and integrated circuits (IC), and some factories are expected to establish chip diffusion facilities for IC's. Further production of molds and dies for stamping IC lead frames is planned, and facilities are being established to plate IC leads. Philips of the Netherlands plans to build a new factory to manufacture IC's and semiconductors in Hong Kong.

The types of laboratory instruments needed during the 1974-79 period will include the following:

- Frequency counters
- Voltmeters
- Very low frequency receivers
- Microvolt meters
- Transfer systems
- Frequency generators
- Oscilloscopes

Laboratories in the textile industry.—Hong Kong's textile exports have grown dramatically in recent years, from $154 million in 1970 to $219 million in 1972 and $458 million in 1973. The industry employs 260,000 workers in the production of a wide range of textiles and related products. Clothing manufacture, the largest sector, had nearly 5,000 plants with more than 180,000 employers in 1973.

The textile industry spent $78,000 for laboratory instruments in 1974 and is forecast to invest $90,000 in 1979. Most of the instruments are used in the spinning, weaving, and finishing sectors. The three sectors combined employed 72,000 workers in 1973. Eleven factories had over 1,000 employees, and 21 plants had from 500 to 999 workers.

There are five large laboratories in the textile industry. Those located in the factories of Textile Alliance Ltd., Central Textile (HK) Ltd., and South Sea Textile Manufacturing Co. are engaged in testing yarn evenness, fiber content, and yarn faults. The laboratories belonging to the China Dyeing Works Ltd. and South China Bleaching and Dyeing Factory Ltd. test textile strength, colorfastness, crease resistance, and various other chemical and physical properties related to color and material strength. Labor-intensive operations are still used in these laboratories.

Industry experts agree that the future growth of Hong Kong's textile industry depends on improving the quality of the products and developing more sophisticated goods. Efforts to upgrade the industry will require more laboratory instruments, particularly those for testing synthetic fibers and knitted fabrics. The highest demand over the next 5 years is expected for the following instruments.

- Fiber strength testers
- Precision balances
- Conditioning ovens
- Crease resistance testers
- Moisture testers
- Spectrophotometers
- Various other physical strength testers

Trade and Technical Regulations

Hong Kong is a free port and does not levy duties or taxes on equipment or instruments. There are no legal technical standards to which laboratory instruments must conform; instrumentation geared to U.S. standards is acceptable and in some cases is preferred.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Hong Kong is available on a continuing basis from:

Country Marketing Manager-Hong Kong
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

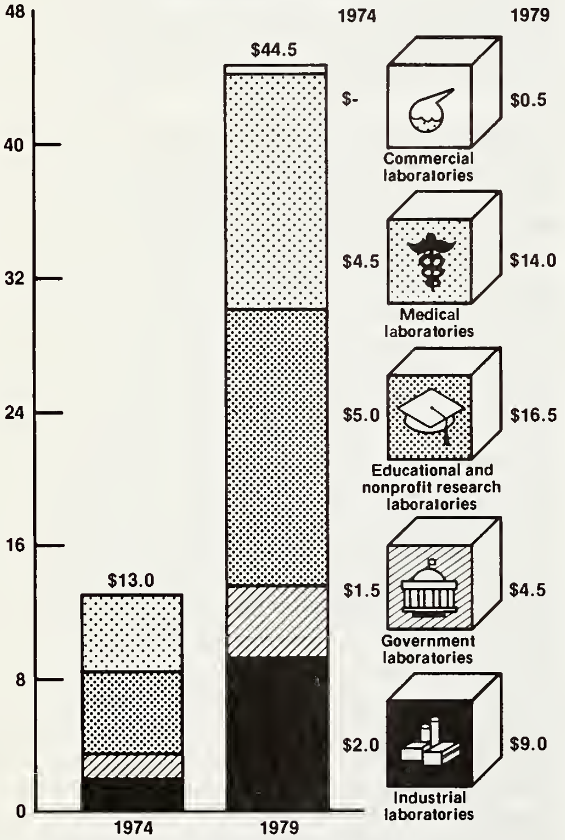
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments— Hong Kong," DIB 76-10-505, February 1975.

Iran

The market for laboratory instruments in Iran is expected to maintain steady growth at a healthy 28% average annual rate from 1974 to 1979. Extensive government financial support for the development of local research facilities is a major factor contributing to the projected 1979 market, which is forecast at more than $44 million[1] (see figure 1). Sales were $8 million in 1972, increased to $13 million in 1974, and registered an estimated $17 million in 1975 (see table 1).

Figure 1. Iran: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Source : Bureau of International Commerce, Office of International Marketing research report; values based on Iranian trade source estimates.

Educational and nonprofit research facilities, which comprised the largest end-user market for laboratory instruments in 1974, are expected to maintain that position in 1979 with purchases of close to $17 million. These research organizations are interested in acquiring both new equipment and replacements for older instruments. Significant funds for the training of personnel to staff laboratory facilities are included in the Government's program to foster the growth of research and development (R&D) in Iran, and provide an additional stimulus to purchases by the educational and nonprofit research sector. Laboratory expenditures by this group are expected to average a rapid 26% increase annually, reaching $94 million in 1979.

The medical sector, characterized by massive expansion and construction programs, constitutes another important group of purchasers of laboratory instruments. Laboratory expenditures by this sector are anticipated to rise at an average 26% annually from the $26-million level of 1974 until the end of the decade.

Iranian industry is currently drawing increased government funding for R&D efforts. Industrial purchases of laboratory instruments are expected to grow at an average annual rate exceeding 35%, from $2 million in 1974 to $9 million in 1979. Oil and gas extraction as well as chemicals production are Iran's most significant industrial sectors as reflected in R&D expenditures. The oil and gas extraction industry is expected to spend over $2 million on laboratory instruments in 1979. Laboratory expenditures by this group are predicted to average exceptionally high growth of 42% annually and reach over $12 million in 1979. The

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = Rials 75.75 (1972); Rials 69.30 (1973 and subsequent years).

Table 1.—Iran: Total imports and imports from the U.S. of laboratory instruments

(in millions of U.S. dollars)

	1972	1974	1975[1]
Total	8.14	13.16	16.8
From the U.S.	1.64	2.50	3.4

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[1] Estimates.

Source: Data based on *Foreign Trade Statistics of Iran*, 1972-74 and trade source estimates.

chemicals industry is forecast to step up purchases of laboratory instruments ($400,000 in 1974) by an average 38% annually between 1974 and 1979; laboratory expenditures by firms in this sector are expected to grow at an equally rapid pace.

Competitive Environment

In Iran, laboratory instruments are supplied entirely by foreign firms. American and German companies hold impressive shares of the market; manufacturers from the United Kingdom, France, Switzerland, and Japan also provide significant portions (see table 2).

American firms, the second largest suppliers, have continually held an average share of about 20% of total sales of laboratory instruments during the 1972-75 period. Trade sources predict that the U.S. proportion of the market for these products should increase to approximately 25% by 1979, representing sales valued at $11 million, a significant increase over the 1974 level of $2.5 million. This projected growth is based on several factors—the fine reputation for quality, reliability, and accuracy held by U.S.-manufactured instruments; the substantial number of U.S.-trained Iranian professionals working in laboratories; and the existence of a number of international agreements between Iranian and American institutions and industries.

Prominent U.S. suppliers of laboratory instruments to Iran include Packard Instruments, Fisher Scientific, Varian Associates, Coulter Electronics, and Soiltest Inc. U.S. subsidiaries located in various third countries are also active in the Iranian laboratory instruments market; included among these firms are Coulter Electronics of the United Kingdom and Beckman Instruments International of Switzerland. The subsidiaries serve to further strengthen the excellent reputation that Iranian end users accord to U.S. technological leadership.

Several trade sources believe that U.S. sellers of laboratory instruments could capture as much as a 40% share of the total market if they intensified sales promotion techniques and service arrangements. Iran has special need for training workshops, using audiovisual aids, and more visits by expert professionals on behalf of the instrument manufacturer. It is also important for U.S. firms to establish strong relationships with sales agents (generally importers) in Iran. These representatives can be of great assistance in shaping the purchaser's choice, particularly if the agents offer quality marketing services and support activities.

Over 35% of the laboratory instruments imported by Iran in 1974 were of German origin. Germany's prominence in the market can be traced to long-established commercial relationships with Iranian businessmen, timely delivery of products, and the good reputation held by German-produced laboratory equipment. Among the major types of German instruments purchased by Iranian end users are electron microscopes, mass spectrometers, centrifuges, and mechanical appliances for testing physical properties of industrial materials. Leading German manufacturers supplying laboratory instruments to Iran include Carl Zeiss, Ernst Leitz, and Memert.

English manufacturers also enjoy a strong position in the market for laboratory instruments. Examples of popular U.K.-produced instruments among Iranian purchasers are microscopes and diffraction apparatus, medical thermometers, and instruments for controlling and measuring the flow and depth of liquids and gases. Cambridge Scientific Instruments and A.E.I. Scientific are considered important suppliers to the Iranian market.

French firms provide a significant portion of the laboratory instruments sold in Iran; they supply about 39% of the parts and accessories market, as well as centrifuges, hydrometers, thermometers, precision instruments used in physics and chemistry, and some measuring, analyzing, and automatically controlling instruments.

Swiss manufacturers provide balances; mechanical appliances for testing the physical properties of industrial materials; microscopes; and geological, meteorological, and hydrographic equipment. Swiss-made Mettler balances, with their world-renowned reputation for excellence, have captured 40% of the Iranian market for such instruments.

Japan's strength in the Iranian marketplace is enhanced by the outstanding reputation of its optical instruments. Japanese firms supply over 20% of the market for compound optical microscopes; Olympus microscopes are favorites among Iranian end users. Toshiba and Canon are other important suppliers to the laboratory instruments market.

In 1975, laboratory instruments were not manufactured domestically. However, an agreement recently was signed between an Iranian concern and Honeywell (United States) to establish a local facility for the production of electronic equipment, including laboratory instruments. Actual production at this facility is not expected to begin until 1979.

Selected instrument markets.—Research recently conducted for the U.S. Department of Commerce, Office of International Marketing, surveyed the marketing opportunities for 10 selected instruments (see table 3). Purchases in Iran of U.S.-produced *automatic analyzers* are projected to grow at an

Table 2.—Iran: Imports of selected laboratory instruments

(in thousands of U.S. dollars)

Microscopes and diffraction instruments, electron and proton	1973[1]	Hydrometers, thermometers, pryometers, barometers, and similar instruments, nonelectric and nonelectronic	1973[1]	Instruments for physical or chemical analysis, nonelectrical and nonelectronic	1973[1]
United States	329	United States	182	United States	367
Great Britain	264	Germany	184	Great Britain	289
Germany	96	Great Britain	201	Germany	257
Japan	74	France	137	France	132
Other	98	Other	135	Other	387
Total	861	Total	1,739	Total	1,432

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[1] Iranian fiscal year, from March 21, 1973 to March 20, 1974.

Source: Data based on *Foreign Trade Statistics of Iran*, Ministry of Economic Affairs and Finance Custom of Iran.

average annual rate of 42% from 1974 to 1979 with sales reaching $3.4 million in 1979. U.S. manufacturers should supply about 80% of the 1979 market. Medical research institutions probably will be leading purchasers of automatic analyzers in the near future in view of extensive expansion and new construction plans.

Liquid chromatographs are relatively new to Iranian laboratories, and sales are presently dominated by a single American supplier. Estimated to grow at an average rate of around 37% annually between 1974 and 1979, sales of American-made liquid chromatographs are expected to account for about 80% of the total market for these instruments in 1979. U.S.-manufactured instruments are considered more accurate than those sold by other countries and are preferred for this reason.

Nuclear magnetic resonance (NMR) spectrometers are in high demand by many industrial laboratories in Iran, especially for new facilities. U.S.-produced NMR spectrometers supplied the entire market, which totaled $350,000 in 1974. Sales by American firms should exceed $1 million in 1979.

Approximately 80% of the *gas chromatographs* purchased in 1974 were produced in the United States. Packard Instruments is the major U.S. supplier of this instrument. Even though gas chromatographs have been sold in Iran for a number of years, industrial sources say that the market is not yet saturated. Sales opportunities should be strong through 1979, when imports from the United States are expected to total about $1.7 million.

Mass spectrometers are in great demand by the many newly developing industries in Iran. Sales are expected to grow at an average annual rate of 40%, from $400,000 in 1974 to nearly $2.2 million in 1979. As of 1974, German firms had cornered the market, primarily as a result of their aggressive sales campaigning and the renown of their instruments. Trade sources estimate that U.S. companies could acquire as much as a 30% share of the 1979 market.

An average annual increase of 15% is anticipated for sales of *pH meters* from 1974 to 1979; the market for this relatively inexpensive instrument is predicted to reach $240,000 in the latter year. Many different sources supply pH meters. The U.S. share of the market is expected to climb from 30% in 1974 to 50% in 1979 despite a historically low level of promotional effort by American sellers. The market projections for U.S.-made pH meters represent average annual growth of 27% from 1974 to 1979.

Major Purchasers

The major source of research and development funding in Iran from 1974 to 1979 will be the Government. Projections based on the Fifth Five Year Development Plan show that R&D expenditures funded by the Government will grow at an average annual rate of 25% from 1974 to 1979 and exceed $380 million in 1979 (see figure 2). These monies are intended to be used by either the Government itself or government-sponsored institutions.

About 85% of the total R&D budget in Iran is now being spent on the physical, engineering, and life sciences with particular focus on health, hydrology, agriculture, and energy research. The remaining 15% is being allocated to R&D activities in the social sciences and basic educational research.

The Scientific Research Council, a part of the Ministry of Science and Education, handles overall coordination of all government R&D activities. A sizable number of R&D activities in Iran are undertaken by universities on a contractual basis with Government and industry. The Council acts as a link between universities and research centers and between the agricultural and industrial sectors.

Excellent growth is predicted for laboratory expenditures through 1979; budgets indicate increases averaging 28% annually in the 1974-79 period (see table 4). Expenditures are projected at $254 million in 1979, in contrast to the 1974 level of $73.6 million. The laboratory instruments market will likewise experience strong growth in the latter portion of the 1970's, as evidenced by the correspondingly high rate of increase projected for that period.

One of the severe constraints that Iran faces in trying to expand its R&D and laboratory facilities is the shortage of highly trained scientists, engineers, and technicians which are necessary to carry out laboratory work. The Iran sample population census in 1971 calculated that only about 3.3% or 237,000 of its skilled workers consisted of professional and technical people. The Government of Iran is aware of this manpower shortage and is attempting to remedy the situation by financially supporting Iranian efforts to develop intensive education and training programs; by bringing foreign professionals and technicians into the education system; and by sending Iranian students abroad to study advanced research methods and techniques.

Since 1971, the number of Iranian students in medical studies, sciences, agriculture, and engineering has almost doubled, with the total enrollment in these disciplines exceeding 60,000 in 1974. Approximately one-half are learning to be technicians or working for Bachelor of Science degrees, particularly in engineering. About 2,000 Iranian students received training abroad during 1973; half of these studied in the United States.

Educational and nonprofit research laboratories.—The 53 laboratories connected with educational and nonprofit research institutions in Iran reported expenditures of $30 million in 1974 and purchases of instruments valued at $5 million. Trade sources estimate that about 1,800 scientists (university graduates of all disciplines) and 5,500 technicians are employed in this sector. The primary activities of these laboratories include pure scientific research, analytical research (including the development of new methodologies), laboratory work for teaching purposes, and educational and advisory services to the private and public sectors. The 14 largest laboratories account for about 65% to 70% of the total purchases of instruments in the sector. Most of these large facilities are attached to educational, medical, or technical institutions such as Tehran University, Reza Pahlavi Medical College, or the Food Technology College. Their work is varied; the main focal points are in the physical, engineering, and life sciences. Often the large laboratories are interested in experimenting with one of each of the various instruments available on the market. The extent of analytical methods employed by these laboratories is broad. Computers and minicompoters are already being used in the universities' and research institutions' laboratories, and the trend is to expand into complete systems.

One of the newest major research facilities which should offer good sales opportunities is the International Research Center, scheduled to begin operation in 1978. Although little information is being released by the Iranian Government on the specific types of activities the Center will be undertaking, more information should be available in the near future. One of the Center's main objectives will be to answer the broad spectrum of problems concerning Iran's development through basic research in the physical and life sciences.

Table 3.—Iran: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total sales	U.S. sales	Total sales	U.S. sales
Gas chromatographs	700	560	2,140	1,710
Liquid chromatographs	100	90	540	430
Mass spectrometers	400	-	2,150	650
NMR spectrometers	350	350	1,400	1,120
pH meters	120	36	240	120
Densitometers	100	50	200	100
Thermal analyzers	60	24	240	140
Automatic analyzers	850	595	4,250	3,400
Electron microscopes	350		1,070	210
Balances	80	32	160	60

Source: Values based on Iranian trade source estimates.

The eagerness of the laboratories in this sector to advance their research capabilities, combined with the government's financial support, results in excellent sales opportunities for laboratory instruments. In addition to receptivity by the research organizations to sophisticated and innovative laboratory instruments, replacements of equipment should also be in demand. Several organizations indicated that they planned to install new instrumentation over the next 3 years. Some of the products which should be highly salable are:

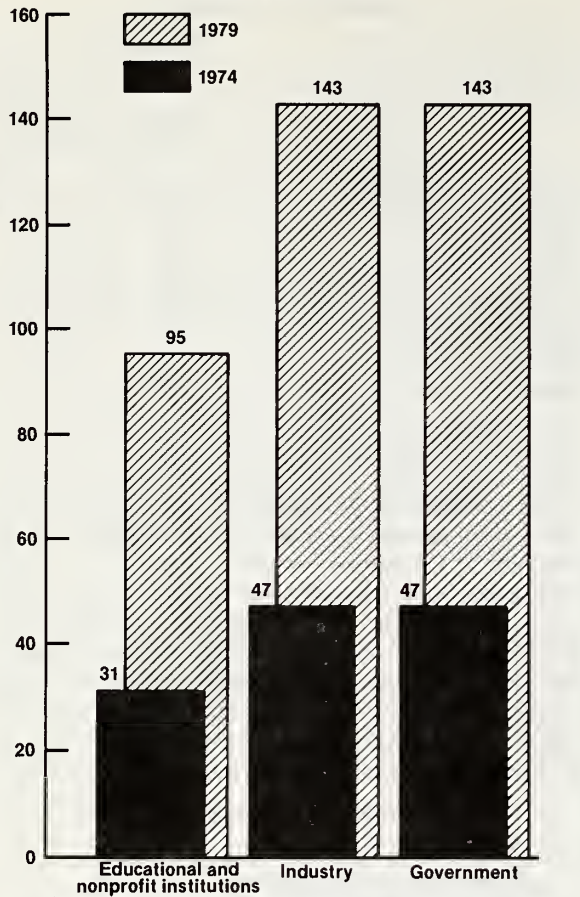
Automatic chemistry and hematology instruments
Nondestructive test equipment
Microchemical analysis apparatus
Microbiology analysis systems
Compound optical microscopes

Laboratories in medical organizations. Laboratory expenditures by this sector are expected to more than triple during 1974-1979 and top $80 million in the latter year. About $14 million will be allocated to the purchase of laboratory instruments in 1979, an average annual increase of 25% from the 1974 level.

Presently there are 284 medical laboratories in Iran. Fourteen of the largest laboratories account for about 60% of the laboratory instrument purchases by medical organizations. Approximately 1,800 people are employed in medical laboratories; some 400 have university degrees in the medical sciences and some 350 are biologists. The remaining 1,000 or so are laboratory technicians.

Among the large laboratories in the medical sector are the Reza Pahlavi Hospital, Reza Shahkabir Hospital, Darius Kahbir Hospital, Pahlavi Medical Center, Bank Melli Hospital, the Ministry of Health Reference Laboratory, and Dr. Habibi Laboratories. The Reference Laboratory acts on a consulting basis with other facilities throughout the country. Dr. Habibi Laboratories exist to serve the needs of private doctors. The hospital laboratories are used chiefly for routine

Figure 2. Iran: R.&D. expenditures,[1/] 1974 and 1979
(in millions of U.S. dollars)



[1/] Represents expenditures on R&D performed in the designated sectors, funded entirely by the Iranian Government.
Source: Values based on Iranian trade source estimates.

medical examinations; some specific research on tissue pathology and nutrition is also performed there.

The fastest growth in the number of laboratories in the medical sector is anticipated for those administered by the Ministry of Health. At present there are 210 such laboratories; the Government plans to add another 400 over the next 4 years. Purchases of laboratory instruments for these new facilities are estimated to be around $10 million.

Another burgeoning group of laboratories constitutes those attached to new hospitals. The Government will be the primary source of financing for these projects; the new laboratories are estimated to require instruments valued at about $40 million between 1975 and 1978.

Some of the major hospital laboratories are already using computers and minicomputers. Market researchers note that there is a definite trend toward complete minicomputer systems.

Sales opportunities should be found for precision instruments through 1979. The following equipment is expected to be in demand.

Nondestructive diagnostic equipment
Automatic chemistry and hematology instruments
Electron and proton microscopes
NMR spectrometers
Basic equipment and instruments for small medical laboratories
Gas chromatographs

Laboratories in the oil and gas extraction industry.—Iranian government investments in the oil and gas industry are projected to increase by 8.9% annually over the 1974-79 period. Total investment amounted to $1.3 billion in 1974 while laboratory expenditures reached $2.1 million, of which $500,000 was used to purchase laboratory instruments.

Employment in the 21 laboratories in this industry approximates 500; about 100 persons work as geologists, chemists, or chemical and petroleum engineers. Eight large laboratories account for about 70% of the laboratory instrument purchases by the oil and gas extraction industry. Some of the largest laboratories are connected with the National Iranian Oil Company, the National Iranian Gas Company, and foreign subsidiaries of Gulf Oil Corporation, Mobil Oil Corporation, Standard Oil Company of California, and The British Petroleum Co.

Laboratory activities are related to oil and gas exploration to increase the known reserves (basically geological and geophysical research); product and raw material quality control; research concerning the effectiveness of oil mulches; and the measurement of air and water pollution resulting from oil and gas extraction. The major analytical methods currently being used in these laboratories are chromatography, calorimetry, and refractometry.

Recently, R&D programs have been initiated on a small scale by laboratories associated with Iranian oil and gas companies. Industrial sources believe that there will be a substantial expansion of R&D activities by these companies in the near future. The National Iranian Oil Company's extensive research budget includes funds for the expansion of its laboratories. The new facilities will be used for air and water pollution control projects and basic oil studies. Third-country subsidiaries in Iran generally have their research and development programs conducted in the parent company laboratories.

Laboratory instruments which should be in heavy demand through 1979 in the oil and gas industry are petroleum testing equipment, absorption meters, colorimeters, hydrometers, refractometers, viscometers, and electron and proton micrometers. Though minicomputers are not yet employed in laboratories belonging to the industry, trade sources predict an emerging interest in the use of complete systems.

Laboratories in the chemical industry.—The Iranian Fifth Five Year Development Plan projects an average annual growth rate of 21% from 1973-1978 for sales in the chemical industry. Volume in 1979 is predicted to exceed $870 million. The chemical industry has allocated an estimated $11 million for

Table 4.—Iran: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	35	$7.0	$25.5	$1.5	$1.5
Educational and nonprofit institutions	53	30.0	94.0	5.0	16.5
Independent commercial laboratories	2	.	2.5	.	.5
Medical organizations	284	26.0	81.0	1.5	11.0
Industry:					
Oil and gas extraction	21	2.1	12.1	.5	2.2
Food products	20	1.3	5.2	.2	.9
Chemicals	44	2.2	11.1	.1	2.0
Petroleum	20	1.8	11.0	.3	1.9
Rubber and plastic products	12	.7	2.3	.1	.11
Stone, clay, and glass	5	.2	.8	.	.1
Primary metals	8	.5	2.0	.1	.4
Fabricated metal products	5	.6	2.3	.1	.4
Transportation	8	.9	3.1	.2	.5
Other	5	.3	1.1	.1	.2
Total	522	$73.6	$254.0	$13.0	$41.5

Source: Values based on Iranian trade source estimates.

laboratory expenditures in 1979; about $2 million will be invested in laboratory instruments that same year.

Except for fertilizer production, which is partially financed by the Government of Iran, funds for capital expenditures in the chemical industry are derived from the private sector. The major products of this industry include pharmaceuticals, cosmetics, detergents, paints, and fertilizer. Synthetics, especially polyester and acrylics, will probably become important in coming years. Du Pont, the Industrial and Mining Development Bank of Iran, and the Industrial Credits Bank of Iran recently formed a joint venture to produce synthetic fibers.

The chemical industry has 44 laboratories that employ between 340 and 400 people. About 100 of the employees are scientists, of whom some 20 are physicians, 50 are chemists or chemical engineers, and the remainder are in various specialties. The 7 largest laboratories purchase about 50% to 60% of all laboratory instruments sold to the chemical industry. These laboratories are connected with the Towlid Darou Co., Darou Paksh, IDI, Pfizer, Parke Davis, ABDI Co., Ltd., Dyrup Iran Co. Ltd., and Shiraz Fertilizer Plant. The basic activities of these large laboratories are product development and quality control, biological tests, animal tests for drug production, and testing for the chemical and physical properties of materials. One of the overall goals of the chemical industry in the 1974-79 period is to increase the production of consumer goods and intermediate chemical materials for local and export markets. A large portion of the product research necessary to reach these goals is being done outside Iran, because most of the chemical factories in Iran are affiliated with foreign companies possessing well-established research facilities in the home country. However, several of the companies are expanding their internal research capabilities, particularly in product lines such as drugs, medicines, fertilizers, and intermediate chemical materials. Most of this locally oriented research is to be conducted in facilities already constructed. Several new industrial plants presently under consideration will contain modern laboratories.

A wide variety of analytical methods is used throughout the laboratories in the chemical industry. Some of the methods include chromatography, colorimetry, electrometric and spectrometric methods. Generally, electronic data processing equipment is not used in the laboratories; however, minicomputers and complete computer systems are gaining attention and may be in brisk demand in several years.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Iran is available on a continuing basis from: a008

Commerce Action Group for the Near East
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments— Iran," DIB 76-02-500, February 1975.

The best sales for laboratory instruments to the chemical industry probably will be of nondestructive test equipment, microbiological test equipment, spectrophotometers, gas chromatographs, centrifuges, and zone readers.

Trade and Technical Regulations

Import regulations are revised by the Government of Iran in March of each year. Although most of the imported instruments are charged a single import tax, some items such as centrifuges, hydrometers, psychrometers, and barometers are charged custom duties plus an ad valorem tax. Both types of tariffs range from 5% to 25% depending on the specific instrument. Current information about Iranian import regulations can be obtained from the U.S. Department of Commerce, Room 3203, Main Commerce Building, Washington, D.C. 20230.

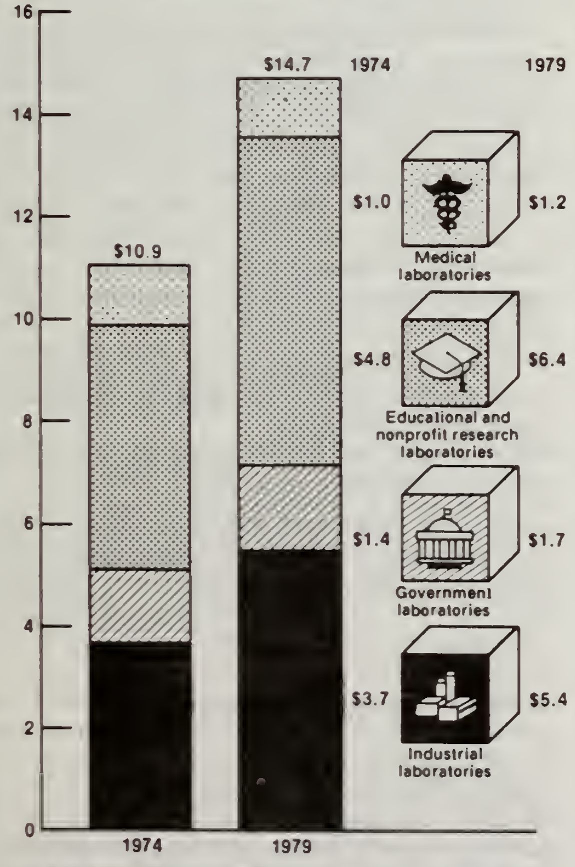
Iran uses the standard European metric system of weights and measures. Electrical power is 220/230 volts and 50 cycles throughout the country.

At the present time, there are no special technical standards applicable to laboratory instruments. Reportedly, the Ministry of Health is studying the possibility of regulations for medical laboratory instruments. Information on the availability of published standards for laboratory instruments in Iran may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

Israel

The sophisticated level of technology maintained in Israeli laboratories and the top national priority accorded research and development (R&D) are among factors stimulating steady growth in the market for laboratory instruments. Sales valued at almost $15 million are expected in 1979 (see figure 1) as expansion of R&D budgets maintains growth at an average yearly rate of 6.6% for the 1974-79 period. Purchases of laboratory instruments rose from $9.6 million[1] in 1972 to almost $10.9 million in 1974 (see table 1). Preductions for 1975 place the market at $11.3 million.

Figure 1 Israel: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Sources Central Bureau of Statistics Supplement to the monthly Bulletin of Statistics Inputs in Research & Development in Research Institutes 1970/71 Vol XXV No 10 October 1974 Dudai Y *Scientific Research in Israel* Projections based on Israeli trade source estimates

As the largest consumers of laboratory instruments, educational and nonprofit institutions provide attractive marketing opportunities. Expansion of existing facilities and construction of several new laboratories should stimulate instrument acquisition projected to total $6.4 million in 1979. This sales volume represents nearly a 6% average yearly increase over the 1974 total of $4.8 million. The gain in value of purchases is attributable to laboratory expenditures that amounted to over $36 million in 1974 and should approach $50 million by 1979.

Marketing prospects also should develop in industrial laboratories, since the growth in instrument purchases by these facilities is averaging almost 7.9% annually, a pace substantially faster than that of the market as a whole. Industry will spend a projected $5.4 million for laboratory instruments in 1979, in contrast to the $3.7 million spent on these items during 1974.

Increases in laboratory expenditures by medical and governmental laboratories between 1974 and 1979 also will boost laboratory instrument sales. For the medical facilities, trade sources foresee instrument purchases amounting to $1.2 million in 1979 with laboratory spending projected to climb from $5.5 million in 1974 to $7.4 million in 1979. Outlays of governmental laboratories should also rise slightly, reaching $8 million by 1979, with sales of instruments to these laboratories amounting to $1.7 million in that year.

Competitive Environment

End users of laboratory instruments in Israel depend almost entirely on imports. Purchases from foreign sources accounted for nearly 98% of total sales in 1974.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = IL 4.20 (1971-1973); U.S. $1.00 = IL 6.00 (1974 and subsequent years).

Trade sources predict that 1979 sales of laboratory instruments from foreign countries will total $14 million. Imports rose from $9.4 million in 1972 to $11.9 million in 1973. Initiation of budget cuts and currency devaluation were partly responsible for a decline to $10.6 million in the import market during 1974. Some recovery is expected in 1975 as the value of products purchased from foreign suppliers should reach an estimated $11 million.

Table 1.—Israel: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	.95	1.15	1.3
Imports	9.39	10.61	11.0
Exports	.73	.88	1.0
Market size[1]	9.61	10.88	11.3

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[1] Market size equals production plus imports minus exports.

Sources: 1972 and 1974 data based on *Foreign Trade Statistics Quarterly* and Country and Part II—Exports by Commodity and Country. Vol. V No. 4 January-December 1973. Data for January-September and *Science Based Industries—Israel 1974;* Ministry of Commerce and Industry; 1975 data based on trade source estimates.

American manufacturers are the leading suppliers of laboratory instruments in Israel (see table 2). They have an outstanding reputation, particularly for their gas and liquid chromatographs, nuclear magnetic resonance (NMR) spectrometers, and thermal analyzers. The $4.4 million worth of U.S. instruments imported during 1974 comprised almost 42% of the import market. Trade sources predict that the share held by American companies will expand to 45% with sales totaling over $6.4 million in 1979.

At present approximately 25 U.S. manufacturers market laboratory instruments in Israel. Among the most important are Packard Instruments (selling gas chromatographs); Beckman Instruments (automatic analyzers); Coleman (pH meters, spectrometers, analyzers, and flame photometers); du Pont Sorval (mass spectrometers, analytical instruments, and chromatographs); Perkin-Elmer (NMR, atomic absorption, mass spectrometers, and gas chromatographs); Varian Associates (mass and nuclear magnetic resonance spectrometers, and gas and liquid chromatographs); and Fisher Scientific (pH analyzers, automatic analyzers, and balances). In addition, Honeywell and Precision Instrument Company make substantial sales in Israel. U.S. goods also enter the Israeli market through European subsidiaries of American companies. Among them are Coulter Electronic (United Kingdom) and Switzerland's Beckman Instruments International.

Producers in Germany are also major contenders for Israeli sales of laboratory instruments; their products have comprised about 20% of imports during the past few years. German compound optical microscopes, balances, apparatus for detecting and measuring radiation, and appliances for mechanical tests are bestselling items.

Instrument manufacturers in the United Kingdom have attained market shares in Israel almost equivalent to those of German firms. Among outstanding British items are mechanical appliances for testing the physical properties of industrial materials. Although not in the leading ranks, Japanese, Dutch, and Swiss manufacturers also make substantial sales in several product categories.

Third-country firms important in the competition for Israeli sales include Brucker and Leitz of Germany and Cambridge Scientific Instruments Ltd., Gallenkamp, and A.E.I. of the United Kingdom. Nikon Optical Works is a major Japanese supplier.

Domestic laboratory instrument producers are expected to increase production at an average annual pace of 10.6% between 1974 and 1979. The value of Israeli production rose from $950,000 in 1972 to $1.15 million in 1974. It is expected to reach nearly $1.9 million by 1979. About 72% of the output for that year is earmarked for export.

The domestic industry comprises only about seven companies, three of which produce the majority of the locally made laboratory instruments. One of the major Israeli enterprises is Elscint Ltd., a manufacturer of scientific instruments, instrumentation for nuclear medicine, and other products, with 1974 laboratory instrument sales amounting to $690,000. Meded Thermometers, Ltd., had sales of nearly $286,000; and El-Hama, which designs and makes pH meters and spectrophotometers, sold over $83,000 in the same year.

Among major manufacturing subsidiaries of foreign firms are the German enterprises Amrel-Meded, Ltd., which makes laboratory thermometers, and Phoenicia-Brand, which produces thermometers and hydrometers.

Selected instrument markets.—Research recently conducted for the Office of International Marketing, U.S. Department of Commerce, surveyed the sales prospects for 10 selected instruments. Within these categories, purchases of *liquid chromatographs* are expected to show the greatest expansion. Trade sources predict average annual growth of nearly 40% between 1974 and 1979 as the market value rises from $300,000 to an estimated $1.6 million during this period (see table 3). American manufacturers are the sole suppliers of these instruments; Varian's liquid chromatograph sales accounted for over one-third of total sales.

Outstanding growth also is expected in the market for *gas chromatographs*, another product supplied entirely by U.S. companies. Packard Instruments is particularly noted for its sales of these devices. Although sold for some time in Israel, the market for chromatographs of this type is not yet saturated. Average yearly growth of almost 20% is projected between 1974 and 1979, and sales are expected to increase from $315,000 to $780,000 during that period.

Purchases of *pH meters* are expected to increase by 15% annually between 1974 and 1979, with a 1974 market valued at $300,000. This relatively inexpensive instrument is locally produced and some competition can be expected from domestic and third-country firms. If there is no specific requirement for accuracy, the locally made instrument is generally purchased in preference to an imported one, because of the favorable price of the former type. Coleman of the United States controls a substantial percentage of these sales.

Makers of *automatic analyzers* should find sales opportunities as a result of the additional demand created by the opening of several new hospital laboratories. Sales, which totaled $335,000 in 1974, are expected to grow at an annual rate of 10%, reaching $540,000 in 1979. Fisher Scientific, Beckman Instruments, and Coleman are prominent in this market.

Average growth of almost 11% annually is expected in the market for *densitometers* between 1974 and 1979. U.S. producers with sales of $60,000 should supply nearly half of the market in 1979. This figure compares favorably to those for 1974 when American manufacturers held 40% of the market.

Trade microsources foresee a healthy demand for *electron microscopes and balances*. Traditionally, however, American manufacturers have not heavily penetrated these markets. Japanese and Dutch producers vie for microscope sales, and the Swiss firm, Mettler, is noted for its balances.

Sales of *mass and nuclear magnetic resonance (NMR) spectrometers and thermal analyzers* maintained at current levels. Marketing opportunities will be tied to instrument acquisition in a few new facilities and replacement in existing laboratories. Varian is the leading supplier of NMR spectrometers to Israel.

Sophisticated methods are most usually employed in Israeli laboratories. Decisions of end users in purchases of laboratory instruments generally are based on the reputation of the manufacturer and the availability of service in Israel. The most advanced type of equipment usually is chosen, regardless of price or national origin of the manufacturer.

Major Purchasers

Growth in the laboratory instrument market accompanies general expansion of R&D in Israel. The funds for these and other research activities in Israel totaled $160 million in 1974 (see figure 2). Trade sources anticipate R&D spending in excess of $200 million in 1979, with approximately 90% of the funds going to engineering and the physical and life sciences. Major government-funded research projects are concerned with medicine, defense, food, ecology, pesticides, and new energy sources. These studies are primarily centered in government laboratories and in those of educational and other nonprofit institutions. The Israeli industries, which depend heavily on export sales, are principally involved in research directed toward product innovation and diversification.

Table 2.—Israel: Imports of Selected laboratory instruments,[1] 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974
Electrical apparatus for physical and chemical analysis			
United States	814	1,457	1,111
Germany	185	129	451
United Kingdom	208	519	286
Netherlands	54	137	43
Other	292	286	375
Total	1,553	2,528	2,266
Nonelectrical apparatus for physical or chemical analysis			
United States	341	340	418
Germany	91	159	119
Sweden	30	100	54
United Kingdom	95	99	54
Other	140	163	112
Total	697	861	757
Apparatus for detecting and measuring radiation			
United States	193	517	195
Germany	22	102	110
Netherlands	36	50	11
France	—	14	7
Other	10	23	22
Total	261	706	345
Compound optical microscopes			
United States	142	34	60
Germany	243	230	259
Japan	186	244	206
Austria	26	92	36
Other	179	153	117
Total	776	753	678

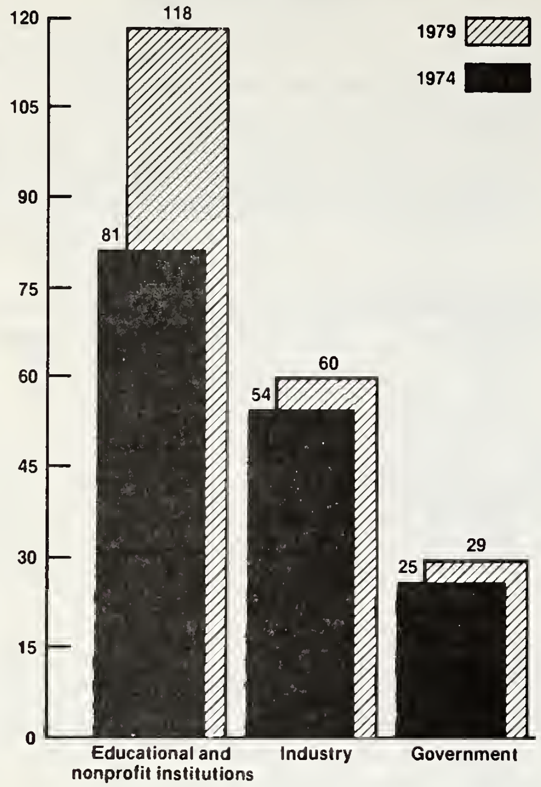
[1] Includes instruments not limited to laboratory use.

Source: Data based on *Foreign Trade Statistics Quarterly*.

The Israeli Government provided $86 million, or nearly 54% of the entire civilian R&D budget, in 1974. That same year, educational and nonprofit institutions supplied $50 million, or about 31% of the total; and industry contributed $24 million, or 15%, of the research allocations. The Government is expected to budget $97 million for R&D in 1979. Funding by industry is projected at $39 million for the same year, and that by educational and other nonprofit institutions, $71 million.

Educational and nonprofit institutions are the largest users of R&D money. Their research spending totaled $81 million in 1974 and is expected to reach $118 million by 1979, with R&D expenditures growing at a

Figure 2. Israel: R.&D. expendeitures,[1] 1974 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the original source of the funds.

Sources: Alexander, E., *Government Funds for Civic Research and Development, for Higher Education and Scientific and Technological Information*. 1966-1973. Dudai, Y., *Scientific Research in Israel. Science Based Industries - Israel, 1974*. Projections based on Israeli trade source estimates.

faster pace than that anticipated for other sectors. Industry use of R&D funds amounted to $54 million in 1974, and estimates place 1979 spending at $60 million. Modest growth also can be expected in the research outlays of the government sector. The R&D budgets in government facilities are projected to increase from $25 million in 1974 to $29 million 5 years later.

Government laboratories.—The National Council for Scientific Research coordinates R&D at the national level. Serving mainly as an administrative body, the Council oversees research carried out by various government ministries and allocates funds for research in other sectors. Government R&D takes place within the framework of these ministries, which operate laboratories for basic research and for testing and evaluation. The control laboratories deal with maintenance of standards for food and drugs, industrial products, and health.

The 18 laboratories operated by the Government reported total expenditures of $7.9 million in 1974 (see table 4). The 1974 total included $1.4 million for purchase of new instruments.

Several major R&D projects are underway in government laboratories. The Agricultural Research Organization investigates field crops, soil and water, horticulture, animal husbandry, agricultural engineering, food technology, and plant protection. Laboratories of the Institute for Negev Research are studying human and animal life in the desert, uses of solar energy, desert vegetation, and climatic conditions. The Geological Survey of Israel conducts laboratory inquiries relating to regional geological surveys and geological history.

Comprehensive research in the life sciences is taking place in the facilities of the Institute of Biological Research, and the Veterinary Institute is studying special problems related to livestock epidemic control and prevention of animal disease. Electro-optics and solar energy, as well as development of turbines, solid-state set detectors, and devices to aid the blind, are ongoing R&D projects at the National Physical Laboratories of Israel, which conducts research on basic physical standards and applied science. A number of facilities investigating defense-related topics also are operated by the Government.

The Israeli Laboratory for Prevention of Air Pollution and Radiation Hazard is slated for expansion in the near future as environmental testing functions increase. This growth is expected to stimulate the heaviest demand for new laboratory instruments in this sector. In other facilities, trends are toward increasing emphasis on pollution control, nuclear energy, and national security.

The analytical methods employed in these and other government facilities include:

Chromatography
Colorimetry
Electrophoresis
Polarimetry
Spectropolarimetry
Electrometric and radiometric methods
Electron microscopy
Refractometry
Turbidimetry
Nephelometry
Spectrometry

Use of computers is still at a minimal level, but use of minicomputers is expected to become more widespread.

Trade sources predict that laboratories in this sector will be interested in purchases of atomic absorption spectrophotometers, particle size analyzers, and instruments to monitor pollution.

Educational and nonprofit research laboratories.—These laboratories offer instrument manufacturers excellent marketing prospects. The organizations attempt to maintain the highest possible levels of sophistication and consistently buy the newest in instrumentation. The laboratories in educational and nonprofit institutions recorded expenditures of over $36 million in 1974 and expect to increase spending to almost $49 million by 1979. The 1974 outlays included $4.8 million for purchase of new laboratory instruments; allocations for this purpose are projected at $6.4 million by 1979.

Among the most important facilities are those at the Bar-Ilan University, Ben Gurion University, Haifa University, the Israel Institute of Technology, Tel Aviv University, The Hebrew University, and Weizman Institute for Scientific Research. Research projects in these institutions deal with medicine, life sciences, physics, agriculture, and industrial development. A major area of emphasis for the future is expected to be energy; focus will be on seeking alternative sources and the development of atomic energy.

Expansion plans for the 1974-79 period include construction of a new Food Technology Institute and a laboratory in a teacher training institute, as well as enlargement of facilities in two teaching laboratories and a research facility.

The wide spectrum of analytical procedures employed in the large laboratories of this sector encompasses:

- Chromatography
- Colorimetry
- Electrography
- Electrometric methods
- Electron microscopy
- Electron paramagnetic resonance
- Electrophoresis
- Magnetic susceptibility
- Mass and NMR spectrometry
- Particle size analysis
- Polarimetry and spectropolarimetry
- Radiometric methods
- Refractometry
- Saccharimetry
- Spectrometric, X-ray, and thermal methods
- Turbidimetry
- Nephelometry

Most educational and nonprofit laboratories also make use of computers and minicomputers, and management is interested in new computer technology.

The anticipated expansion and new construction will create demand for NMR spectrometers, scintillation equipment, and electron microscopes.

Laboratories in the chemical industry.—Instrument purchases by the Israeli chemical industry, the largest industrial end user of laboratory equipment, are expected to increase at an average annual pace of more than 10% between 1974 and 1979. This rise, substantially faster than the projected growth of the market as a whole, accompanies rapid expansion of the chemical industry. Sales by chemical firms are predicted to climb steeply, as expansion of the industry is sustained at the average rate of 15% annually through 1979. Especially rapid growth is expected to continue in production of agricultural chemicals and pharmaceuticals.

The 45 laboratories within this industry had expenditures of over $10 million in 1974. Instrument purchases in that same year amounted to $1.6 million. Total 1979 spending for laboratories as a whole is projected at $13.5 million, of which $2.6 million will be devoted to instrument acquisition. The personnel employed by these and other laboratories in the chemical industry consist of 40% academicians and scientists, 30% technicians, and 30% administrative workers.

Table 3.—Israel: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total	U.S.	Total	U.S.
Gas chromatographs	315	315	780	780
Liquid chromatographs	300	300	1,610	1,610
Mass spectrometers	450	99	450	110
NMR spectrometers	470	470	470	470
pH meters	300	150	600	270
Densitometers	72	29	120	60
Thermal analyzers	15	15	20	20
Automatic analyzers	335	134	540	240
Electron microscopes	92	—	150	30
Balances	260	5	520	50

Source: Values based on Israeli trade source estimates.

Current R&D projects for the chemical industry are concerned with product control and development, as well as examination of raw materials and investigation of possible new uses for them. An extensive R&D program is underway at Chemical and Phosphates Ltd., which operates one of the largest laboratories in this industry and produces fertilizers, feed additives, and other chemicals. Activities center around product quality control, surveys for new raw materials, and development and testing of new products for agricultural crops.

Another large facility is run by Assia Chemical Laboratories Ltd., a manufacturer of pharmaceuticals, fine chemicals, and preparations for veterinary use. Major functions of the laboratory are quality control, new product development, and testing of drugs.

Investigations of new products and quality control also are the major tasks of laboratories in Bromine Compounds Ltd., Mackhteshim Beersheba Chemical Works Ltd., Askar-Tambour Ltd., Electrochemical Industries Inc., Teva-Middle East Pharmaceutical & Chemical Works Ltd., and Zion Chemical Products Ltd. Facilities associated with Folkman and Dr. Koffler Ltd. and Dead Sea Works Ltd. perform these functions and also assist in development and improvement of production methods.

Trade sources foresee expansion of R&D in the chemical industry at the impressive average yearly rate of 30% in the 1974-79 period. This substantial increase is expected to result from continuation of current projects, since national economic policies may prevent initiation of ambitious new programs.

Table 4.—Israel: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	18	7.9	8.1	1.4	1.7
Educational and nonprofit institutions	15	36.1	48.9	4.8	6.4
Medical organizations	18	5.5	7.4	1.0	1.2
Industry:					
Oil and gas extraction	2	1.5	1.7	.3	.4
Food products	16	2.8	3.0	.5	.6
Chemicals	45	10.4	13.5	1.6	2.6
Rubber and plastic products	8	.7	.7	.1	.1
Stone, clay, and glass	4	.5	.6	.1	.1
Primary metals	2	1.0	1.3	.2	.3
Fabricated metal products	4	1.2	1.4	.2	.3
Transportation	5	1.8	2.3	.3	.4
Other	15	3.1	3.1	.4	.66
Total	152	72.5	92.0	10.9	14.7

Sources: 1974 data based on *Inputs in Research and Development in Research Institutes 1970/71*, Vol XXV, No. 10, October, 1974. Dudai, Y. *Research in Israel.* Projections based on Israeli trade source estimates.

Analytical methods utilized in laboratories serving this industry include:

Atomic absorption
Chromatography
Colorimetry
Mass and NMR spectrometry
Particle size analysis
Polarimetry and spectropolarimetry
Refractometry
Turbidimetry
Nephelometry
X-ray analysis

Use of electronic data processing in these facilities is limited. If the parent firm owns a computer, the laboratory makes use of it for analysis of laboratory tests. No facilities own minicomputers, and none plan to purchase any in the next 5 years.

The industry is expected to provide good sales opportunities for refractometers and thermal analyzers. Mass, infrared, and NMR spectrometers, as well as microscopes, also should be in demand.

Laboratories in the food products industry.—Laboratory instrument manufacturers can expect sales opportunities as this sector, as it expands at an average annual rate of 9% between 1974 and 1979, steps up its R&D concerning food products. Food processors recorded sales of almost $763 million in 1973, when capital expenditures amounted to almost $48 million. In the same year, laboratory expenditures in this industry totaled $2.8 million, and new laboratory instrument purchases reached $500,000. Trade sources anticipate that 1979 expenditures for laboratories will total $3 million, with $600,000 invested in new instruments.

Laboratories owned by Miloda, Assis, and Etz-Haziat-Edible Oil Industries, Ltd. comprise the large facilities serving this industry. Thirteen laboratories are operated by other food processors. About one-third of the personnel in these facilities are scientists. Their research activities are principally concerned with development of new specialty or gourmet food products. Other major functions include quality control of raw materials and of final products, as well as tests for new raw materials.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Israel is available on a continuing basis from:

Country Marketing Manager-Israel
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments— Israel," DIB 76-07-501, May 1975.

Albumin protein research and investigation of oils for human consumption are subjects for future R&D emphasis.

Laboratories in the food products industry employ the following analytical methods:

Chromatography
Colorimetry
Particle size analysis
Refractometry
Saccharimetry
Spectrometric and thermal methods
Turbidimetry
Nephelometry

Although use of data processing equipment is at a minimal level, expansion is not expected. Instruments with good sales prospects include albumin and amino acid analyzers, analytical apparatus for automatic titration, centrifuges, flame spectrometers, and gas chromatographs.

Trade and Technical Regulations

Customs duties that vary from 10% to 30% are levied against many categories of laboratory instruments, but certain types can be imported without these charges. In addition, all imported goods coming into Israel are subject to the special Government Defense Tax. No countries receive preferential rates or are entitled to duty-free trade. Additional information concerning official tariffs may be obtained from the U.S. Department of Commerce, Room 5015, Main Commerce Building, Washington, D.C. 20230.

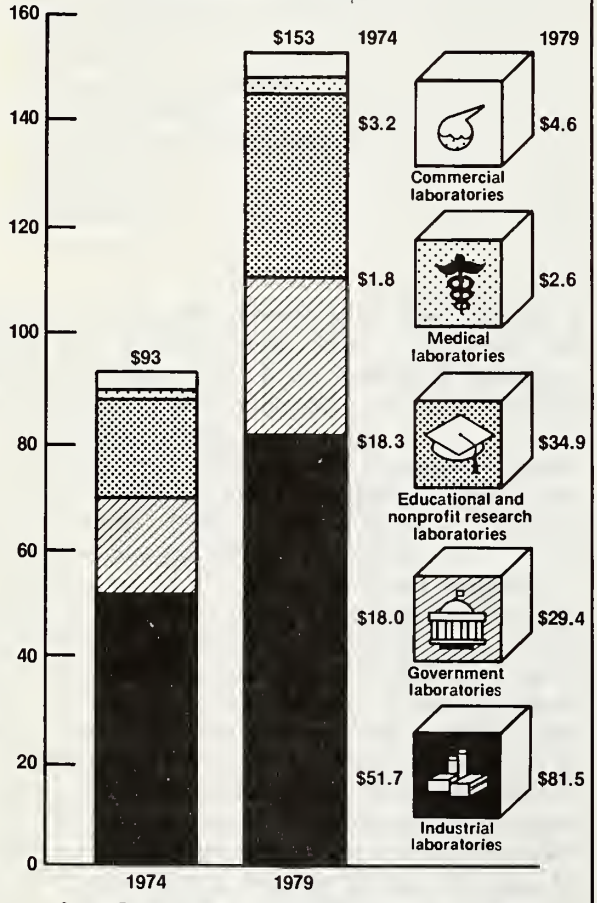
The electrical power supply characteristics throughout Israel are 230 volts, 50 hertz, single-phase. In addition, 380 volts, 3-phase is available for heavyduty equipment.

The metric system of weights and measures is the statutory standard in Israel. Published national standards in Israel may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

Italy

U.S. producers of technologically sophisticated laboratory instruments will find excellent sales opportunities in the large, rapidly growing market in Italy. Expenditures for laboratory instruments rose from $70 million[1] in 1972 to $93 million in 1974, increasing at an average 15.3% yearly (see table 1). The market reached $103 million in 1975. Growth at the average annual rate of 10.5% is predicted for the 1974-79 period. The 1979 market is expected to total $153 million as government concern about environmental and energy problems spurs research activities and as heightened international competition encourages research and development (R&D) in industry (see figure 1).

Figure 1. Italy: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report. Values based on Italian trade source estimates

The industrial programs directed toward product innovation and diversification are expected to create a major source of new demand for laboratory equipment. Instrument sales to industrial laboratories are projected to rise at an average pace of 9.3% yearly between 1974 and 1979. Italian industries spent nearly $52 million for new laboratory instruments in 1974; predictions place 1979 outlays at over $81 million.

Anticipated R&D projects on alternate energy sources, transportation, solid-waste disposal, and pollution are expected to contribute to increased purchasing of laboratory instruments in governgovernment facilities. Sales to these laboratories are forecast to rise at a projected average annual rate of more than 10%, from $18 million in 1974 to almost $30 million in 1979.

Laboratories in educational and other nonprofit institutions anticipate increased outlays for instruments because of rising enrollment in universities and enlargement of their facilities as well as expansion of research programs in nonprofit institutions. With projected average annual growth at the rate of 13.8% between 1974 and 1979, sales should total almost $35 million by the latter date, in contrast to the $18 million expended in 1974.

Italian medical laboratories look forward to stepping up spending for instruments, as newly enacted health reform legislation is implemented. Purchases of laboratory instruments are projected to rise from $1.8 million to $2.6 million during the 1974-79 period.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = 583 Lit (1972 and 1973); 650 Lit (1974 and subsequent years).

Table 1.—Italy: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	26	31	35
Imports	60	82	90
Exports	16	20	22
Market size[1]	70	93	103

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[1] Market size equals production plus imports minus exports.
Source: Values based on Italian trade source estimates.

Trade sources also foresee a rise in instrument sales to independent commercial laboratories. These facilities, which invested $3.2 million in 1974, are expected to spend $4.6 million on new instruments in 1979.

Competitive Environment

Imports supply the bulk of instruments used in Italian laboratories, including virtually all of the most advanced equipment. Foreign sales totaled $60 million in 1972; 2 years later their value had risen to $82 million. During the 1974-79 period, average growth estimated at 10.7% per year is expected as the value of products sold by foreign companies rises to $136 million.

U.S. manufacturers supply an impressive 35% of laboratory instrument imports, and American industry's share is even higher if sales by their subsidiaries in Germany and elsewhere are included. Imports from America valued at close to $30 million were purchased by Italian end users during 1974. Sales are expected to reach nearly $48 million in 1979, keeping pace with the average rise in imports.

Italian end users find that the quality, reliability, accuracy, and technical superiority of American products more than justify their higher cost. U.S. equipment predominates in the high-technology, high-cost categories, and U.S. makers are the major suppliers of electronic equipment (see table 2). American companies are noted for dependable servicing capability and ready availability of parts and personnel; training facilities are considered good.

One of the first U.S. companies considered when new equipment must be purchased is Hewlett-Packard, which has an excellent reputation among Italian end users. The firm sells electronic, biomedical, and analytical instruments produced in German and American plants; it dominates the spectrum analyzer market and is very strong in sales of gas chromatographs.

Perkin-Elmer is known for atomic absorption instruments and infrared (IR) spectrophotometers. It also holds large shares in the markets for gas chromatographs, automatic analyzers, thermal analyzers, mass spectrometers, and liquid chromatographs.

Varian, which leads in liquid chromatograph and mass spectrometer sales, also enjoys a strong position in the market for nuclear magnetic resonance (NMR) spectrometers (produced in Germany), gas chromatographs, atomic absorption devices, and ultraviolet (UV)-visible spectrophotometers.

Beckman Instruments is outstanding for sales of UV-visible spectrophotometers, IR spectrophotometers, and two-beam atomic absorption devices.

Among other noted suppliers are Bush Instruments (recorders); Tektronix (oscilloscopes); Waters Associates (chromatographs); John Fluke Manufacturing (digital voltmeters); Leeds & Northrup (thermal and gas analyzers); Bausch & Lomb (UV-visible spectrometers); du Pont (thermal analyzers, liquid chromatographs); Advanced Metals Research (electron microscopes); and Technicon (automatic analyzers, spectrometers, biomedical instrumentation). American Research Laboratory supplies X-ray analyzers from a plant in Switzerland.

Several U.S. companies also manufacture instruments in Italy. Leeds & Northrup Italiana makes oxygen analyzers, pH meters, IR analyzers, and other instruments. Instrumentation Laboratory builds flame photometers and pH meters. Gelman Instruments produces thermostatic stoves and air corpuscle counters.

Third-country suppliers are traditionally strong in sales of nonelectric precision laboratory instruments such as optical microscopes and balances. In recent years, however, they have moved aggressively into more sophisticated, highly automated electrical and electronic equipment markets, and they now pose strong competition to U.S. suppliers.

Purchases from German manufacturers comprise about 25% of the total laboratory instrument imports. Among the major German suppliers are Carl Zeiss (optical densitometers, optical microscopes, UV-visible spectrophotometers, one-beam atomic absorption instruments); Leitz (optical and electron microscopes); Siemens (electron microscopes, X-ray analyzers); and Reicher (optical microscopes). Others are Atlas Werke (mass spectrometers); Bruker (large NMR spectrometers); Rode u Schwartz (high frequency generators); Appendorf (UV-visible spectrophotometers); and Wandel u Golderman (high frequency generators).

Laboratory instruments from the United Kingdom make up another 10% of the import market in Italy. Leading British producers active in laboratory instrument sales include Pye Unicam (X-ray analyzers, UV-visible spectrophotometers, liquid chromatographs); Joyce, Loebl (microdensitometers); AEI (high-resolution mass spectrometers); Ilger and Watts (IR spectrophotometers); and Marconi (spectrum and X-ray analyzers).

Imports from the Netherlands also make up 10% of the total imports. Philips is the major third-country supplier in Italy; it dominates the markets for X-ray and spectrum analyzers and is a sales leader in electron microscopes, atomic absorption instruments, UV-visible spectrophotometers, IR spectrophotometers, and liquid chromatographs.

Swiss, Japanese, and Swedish laboratory instrument manufacturers hold lower import market shares. Swiss companies of importance include Mettler (balances, thermal analyzers) and Kontron (automatic analyzers). Recently, Japanese suppliers have made inroads into the less complex equipment markets. They appear to be competing successfully in spite of tariff disadvantages and meager after-sales service. Leading Japanese suppliers are JEOL (electron microscopes, mass and NMR spectrometers) and Hitachi (mass and NMR spectrometers, electron microscopes). LKB of Sweden is also active in the Italian market (mass spectrometers, oxygen analyzers).

Italian output of laboratory instruments reached $31 million in 1974 and is projected at $50 million in 1979. About 14 of the approximately 100 companies that comprise the domestic industry account for an estimated one-half of total production. Although one or two companies are venturing into manufacture of technologically advanced instruments, the majority of production consists of inexpensive, nonelectronic equipment with low levels of sophistication. Local firms excel in sales to educational laboratories where there is a need for inexpensive, basic instrumentation.

Officine Galileo, the largest Italian manufacturer, makes optical instruments, spectrometers, balances, polarimeters, refractometers, and spectrophotometers. The firm's annual sales are approximately $5 million, and laboratory instruments make up 80% of its production. Carlo Erba Strumentazione, a subsidiary of a firm in the Montedison Group, ranks second as a producer of laboratory instruments and also distributes imported items. About half its sales, estimated at a total $6 million yearly, comprise laboratory instruments. The company's major products are gas chromatographs; porosimeters; and colorimetric, automatic, and amino acid analyzers. Carlo Erba makes gas chromatographs reputed to be of top quality and competes successfully in the world market for these instruments. Carlo Erba also is developing a line of liquid chromatographs for introduction on the Italian market. Optica, with annual sales of $2.5 million in 1974, makes X-ray and amino acid analyzers, densitometers, single- and double-beam atomic absorption devices, and direct-reading emission spectrometers.

Gibertini, noted for analytical and thermic scales, reported that about 90% of its annual sales consisted of laboratory instruments in 1974. SIS makes pH meters and pyrometric calibrators; annual sales of laboratory instruments were estimated at $750,000 in 1974. ELVI manufactures densitometers, colorimeters, UV-visible and IR spectrophotometers, pH meters, and other instruments. Its yearly sales of about $1.5 million are composed of 80% laboratory instruments. FAS, with a yearly sales volume of $1.7 million in laboratory instruments, is noted for pH meters. Ciampolini, whose instrument sales totaled approximately $1 million in 1974, produces densitometers, UV-visible spectrophotometers, IR spectrophotometers, pH meters, and spectrofluorometers. About 90% of its production is laboratory instruments.

Table 2.—Italy: Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Laboratory centrifuges			
United States	437	389	768
Germany	360	751	372
Other	289	1,978	366
Total	1,086	3,118	1,506
Spectrographs			
United States	189	194	232
Other	354	482	265
Total	543	676	497
Oscilloscopes			
United States	710	1,500	374
Netherlands	983	695	667
Germany	571	—	—
Other	880	950	595
Total	3,144	3,145	1,636
Ionic radiation meters[2]			
United States	156	290	130
Germany	237	—	—
France	207	302	—
Other	165	144	150
Total	765	736	280
Test devices			
United States	372	681	363
Germany	748	489	727
United Kingdom	379	710	212
Other	268	437	231

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[1] January through June.
[2] 90% are used in laboratories.
Source: Data based on Italian import statistics and trade source estimates.

The Government has no official programs or policies to support the domestic industry. However, Montedison, an enterprise partially owned and controlled by the Government, is acquiring smaller companies in an effort to consolidate the laboratory instrument industry.

Selected instruments.—Research was recently conducted in Italy for the Office of International Marketing, Bureau of International Commerce, on sales of 15 instruments selected as market indicators. According to the survey, rapid expansion can be expected in the Italian market for ***UV-visible spectrophotometers***. Sales totaled $4 million in 1974 (see table 3), and trade sources expect the value of purchases to reach $7.4 million a year by 1979. The trend is toward increased purchases of large units, particularly those with digital dials. Italian producers hope to add sophisticated models to their product lines in order to participate in the above-average growth of this sector. U.S. producers are expected to maintain their substantial 40% share of this market.

The large market for *automatic analyzers* also has good prospects for growth. The plans for reform in national health services are expected to help raise sales from $3 million in 1974 to $5 million in 1979,

Table 3.—Italy: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatographs	2,500	500	875	1,125	3,370	560	1,480	1,660
Liquid chromatographs	600	540	60	—	1,100	770	110	220
Mass spectrometers	500	150	350	—	750	230	520	—
NMR spectrometers	850	595	255	—	1,350	950	400	—
pH meters	350	18	52	280	550	30	80	440
Densitometers	250	75	125	50	420	150	230	40
Thermal analyzers	500	50	300	150	800	80	480	240
Automatic analyzers	3,000	1,500	1,200	300	5,000	2,500	2,000	500
Electron microscopes	500	100	400	—	800	160	640	—
X-ray analyzers	2,600	260	2,080	260	4,200	420	3,750	210
Balances	2,000	—	800	1,200	3,400	—	1,360	2,040
Oxygen analyzers	250	100	125	25	400	160	200	40
Atomic absorption instruments	1,500	900	450	150	2,850	1,170	850	290
UV-visible spectrophotometers	4,000	1,600	2,000	400	7,400	2,960	3,700	740
IR spectrophotometers	1,500	900	600	—	2,500	1,500	1,000	—

Source: Values based on Italian trade source estimates.

representing average growth of about 11% yearly. At present, large hospitals and research laboratories are major end users, but future sales opportunities probably will shift to small and medium-size analytical laboratories. American manufacturers should hold their 50% share of the market.

Third-country suppliers dominate the *X-ray analyzer* market, which is forecast to grow at an average rate of about 10% annually and exceed $4 million in 1979. Among the major end-user industries—metallurgical, glass, ceramic, cement, and petroleum—the trend is toward use of X-ray analysis in process and quality control rather than in research. Universities continue to use these instruments, especially in geological, mineralogical, and petroleum research.

Gas chromatograph sales, which totaled $2.5 million in 1974, are projected to reach $3.7 million in 1979. Compact and economical equipment that now comprises one-half of the market is likely to become more popular, particularly in medium-size laboratories of pharmaceutical companies. Equipment with automatic sampling capabilities and instruments integrated with computers also show growth potential. Including products manufactured through German subsidiaries, the shares of U.S. suppliers make up about half of the market.

Sales of *balances* are forecast to exceed $3.4 million in 1979. This market is dominated by domestic producers, who supply 60% of the local requirements. The Swiss manufacturer, Mettler, also is a market leader. The *atomic absorption instrument* market is large and growing rapidly at a projected annual average of 13.8%, from $1.5 million in 1974 to $2.5 million in 1979. Metallurgical, chemical, and pharmaceutical industries account for about 60% of the sales. Hospitals make up another 20% and nonprofit institutions, 20%. A new flameless sampling system is becoming widely popular because of its large capacity, and future applications may include ecological control. American manufacturers can look forward to retaining their 60% share of the Italian market for this equipment.

Purchases of *IR spectrophotometers* will increase by an average annual rate of 10.7% in the 1974-79 period, with sales totaling $2.5 million by the latter year. Future applications by the major end users, the chemical industry and nonprofit institutions, include employment of these instruments for pollution control. Colorimeters are generally being replaced by spectrophotometers in Italy. The fixed/passing-band type in particular is considered attractive due to its competitive price. U.S. suppliers are expected to maintain their 60% market share.

The market for *NMR spectrometers* is projected to grow from $850,000 in 1974 to $1.3 million in 1979, as their use becomes more widespread in laboratories of medium-size pharmaceutical manufacturers and producers of organic chemicals. U.S. firms supplied 70% of the Italian requirements for these instruments in 1974, and their share is not forecast to decline.

Although not constituting a large market at present, *liquid chromatographs* have good growth potential. The 13% average annual rate of increase predicted for the 1974-79 period is much higher than that of the market as a whole. This type of chromatograph has been utilized in Italy only during the past 4 or 5 years, and the market is not yet saturated. Although there is no domestic production at this time, Carlo Erba Strumentazione is expected to introduce a model to compete with those of foreign suppliers.

The market for *mass spectrometers*, somewhat restricted because of high unit price, is expected to grow from $500,000 in 1974 to $750,000 in 1979. This market is divided between U.S. producers, who supply about 30%, and third-country manufacturers. There is no domestic production.

Demand for ***electron microscopes*** is expected to increase as future applications in air pollution control and pathological diagnosis stimulate demand. Demand for these instruments and for ***thermal analyzers*** is satisfied primarily by third-country suppliers. Trade sources estimate that end users will invest $800,000 in each of these instruments during 1979.

The market for ***pH meters*** is small and dominated by Italian producers. Purchases of ***oxygen analyzers*** are expected to total about $400,000 in 1979, up from $250,000 in 1974. U.S. producers hold 40% of the market. ***Densitometers*** represent another market with a low sales volume, but prospects for growth are good. Sales of these instruments, $250,000 in 1974, are expected to reach $420,000 in 1979, and the share supplied by imports is likely to increase.

Major Purchasers

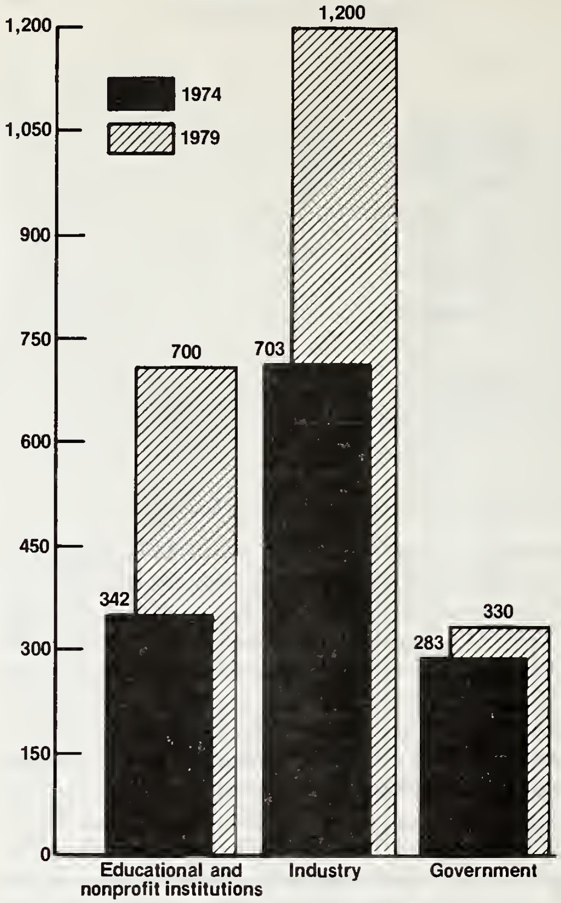
The increasing consumption of laboratory instruments has resulted from healthy expansion of R&D in Italy. Recognition that Italian-made products can no longer compete in international markets on the basis of lower costs is sparking significant R&D activities in product innovation. As part of this effort, production capabilities in the chemical industry are being expanded from manufacture of plastics, synthetic fibers, fertilizers, and resins to output of items with higher profit potentials, such as cosmetics, adhesives, and detergents. Some major companies also are expanding into new lines. In addition, the R&D phase of a program to modernize and expand the Italian telecommunications system is being funded and undertaken by producers of communications equipment.

The Government plans to increase spending for studies of water pollution, air pollution, and solid waste, and to invest in health facilities and public transportation. The development of new energy sources also is being emphasized; the state electrical utility, ENEL, the Italian Nuclear Energy Commission, and Comitato Nazionale Ricerche (CNR, the government research council) are dividing $113 million for research projects in this field. Moreover, $54 million has been earmarked for completion of a telecommunications satellite.

Anticipated expansion of total spending for R&D in Italy will average almost 11% yearly between 1974 and 1979, reflecting an increase from $1.3 billion to over $2 billion during that 5-year span. These gains contribute significantly to increases in the laboratory instrument market, since an estimated 80% of the research funds ultimately is used for laboratory expenditures. In addition, about about 95% of the total research budget is devoted to the physical, engineering, and life sciences, the fields in which laboratory instruments are primarily utilized.

The Government supplied about $672 million in R&D funds during 1974, or about 50% of the total. Government participation is expected to be approximately 51% by 1979, with R&D commitments totaling $1.2 billion in that year. Industry provided $634 million, or about 48% of all R&D funds in 1974. Its share is expected to decline to 45% by 1979, when industry expenditures for R&D are projected at $1 billion. Educational and other nonprofit institutions, which are not significant sources of money for research at present, are expected to contribute a larger share in the future. The R&D funds provided by these institutions are predicted to amount to $80 million in 1979, a substantial rise from the 1974 level of $22 million.

Figure 2. Italy: R&D expenditures[1] 1974 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of original source of the funds.

Source: Bollettino Statistico Mensile, ISTAT.

Industry is the chief user of R&D funds (see figure 2). With estimated spending of $1.2 billion in 1979, it ranks far ahead of other sectors. Research expenditures within industry are growing by an average of 11.3% annually from $703 million in 1974.

Between 1974 and 1979, laboratories in educational and nonprofit institutions anticipate a sharp average annual rise of 15.4% in use of R&D funds. These facilities spent about $342 million for this purpose in 1974; annual budgets should total approximately $700 million by 1979. The growth in R&D outlays by government organizations will be much slower than that of other sectors, but the 1979 total is nevertheless projected to reach $330 million.

Table 4. Italy: Number of persons employed as scientists, engineers, and technicians[1] in the physical and life sciences, 1971

	Scientists	Engineers	Technicians
Employed by:			
Government[2]	12,600	8,500	20,100
Industry	10,000	5,500	14,100

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[1] Including part-time personnel.
[2] Including educational and other nonprofit institutions.
Source: Data based on Bollettino Mensile di Statistica published by the Istituto Centrale di Statistica.

An estimated 22,600 scientists, 14,000 engineers, and 34,200 technicians were employed in Italian R&D programs during 1971 (see table 4). Trade sources estimate that since that time the number of professional and technical personnel in industry R&D increased 2.4% per year and those in Government between 1% and 2% annually. Most scientists have been trained in Italian schools; a very small number go abroad to seek the advanced scientific and engineering degrees that are not offered by domestic universities.

Government laboratories.—The R&D funds supplied by the Italian Government are allocated primarily through CNR. This public agency, which reports to the Prime Minister's Office, funds work within its own research organizations and in external scientific institutes. It also grants assistance for establishment and upgrading of scientific laboratories, conducts on-the-job training and continuing education for scientific personnel, sponsors international exchange and cooperation programs, and collaborates in the compilation of technical standards.

There are few areas of specialized government research activities outside of CNR. Exceptions are CNEN, the government-owned electric utility, and the Italian Nuclear Energy Commission, both of which do applied research on new energy sources, and the Ministry of Defense, which conducts R&D in new weapons. The Government also has a state company, Istituto Mobiliare Italiano (IMI), that serves as a funding source to provide loans to small and medium-size companies.

Sales to government laboratories are predicted to rise at an average rate of over 10% annually between 1974 and 1979. Total government laboratory expenditures in these facilities during 1979 are projected at $337 million, and new instrument acquisitions in the same year at almost 30 million.

Most of the approximately 240 laboratories in this sector are large facilities with over 100 employees. The 191 CNR organizations are concerned with physics, chemistry, biology and medicine, mining and geology, engineering, technology, and agronomy. Other specialized government research activities take place in the Centro Applicazioni Militari Energia Nucleare (performs research on military applications of atomic energy), Centro Ricerche Aerospaziale (aerodynamics and space); Istituto Nazionale Tumori (cancer), Istituto de Motori (engines), and numerous other organizations. Recently the research institutes and laboratories in this sector have cooperated in the exchange of information and personnel to maximize research resources.

Almost 21,000 employees worked in research at government laboratories during 1973. Close to 8,000 of them held university degrees. The CNR organizations employed approximately 3,000 scientists, engineers, and technicians in the same year.

The work in government laboratories involves virtually every type of analytical method, particularly chromatography, colorimetry, electrometric methods, electromicroscopy, mass spectrometry, nuclear magnetic resonance, particle size analysis, spectrometric methods, turbidimetry, nephelometry, and X-ray methods. Use of electronic data processing technology has been expanding very rapidly in the government sector since 1969, but at present, applications are primarily statistical. Use of computers as analytical tools is limited to nuclear, space, and electronics R&D. There is a growing trend toward use of minicomputers.

Good sales prospects are likely in connection with expansion of ongoing research projects at the Istituto Tecniche Frutticole, which is primarily concerned with phytopharmacology; the Istituto Ricerche Acque, conducting investigations about ecology; and the Laboratorio Elettronica Stato Solido, doing research on superconductivity. These and other government facilities are expected to offer marketing opportunities for:

Air sampling and analysis equipment
Air, amino acid, electron probe, gas, noise level, particle-size, thermal, turbidity, water, and wave analyzers
Balances
Barometers
Colorimeters
Centrifuges
Gas, liquid, and flame ionization chromatographs
Galvanometers
Hygrometers
Mass and IR spectrometers
Electron and optical microscopes
Oscilloscopes
pH meters
Polarimeters
Spectrophotometers
Turbidimeters
Thermometers
Ultracentrifuges
Voltmeters
X-ray diffractometers

Educational and nonprofit research laboratories.—Laboratories in educational and nonprofit institutions spent over $18 million for instruments during 1974. Purchases will increase at the outstanding average pace of about 14% yearly between 1974 and 1979, reaching nearly $35 million by the end of the 5-year period. Increases in instrument purchases are reflections of rising laboratory expenditures, projected to total almost $365 million in 1979 in comparison to the nearly $215 million expended in 1974.

Table 5.—Italy: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	240	$203	$337	$18.0	$29.4
Educational and nonprofit institutions	1,000	214	365	18.3	34.9
Independent commercial laboratories	100	22	33	3.2	4.6
Medical organizations[1]	60	12	18	1.8	2.6
Industry:					
Electronics	500	92	149	8.7	15.0
Food products	50	5	8	.5	1.1
Chemicals	880	128	174	12.2	17.4
Petroleum	20	5	7	.4	.7
Rubber and plastic products	100	26	35	1.9	3.2
Stone, clay, and glass	40	6	10	.6	1.0
Primary metals	100	20	34	1.5	3.1
Fabricated metal products	800	148	238	12.8	21.2
Transportation equipment	10	2	4	.2	.4
Other	950	149	220	12.9	18.4
Total	4,850	$1,032	$1,632	$93.0	$153.0

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[1] The Government owns and operates 80% of these facilities.

Source: Values based on Italian trade source estimates.

Some of the approximately 1,000 nonprofit laboratories are sponsored by foundations, but a majority are associated with the universities. Among the major research laboratories are several university-affiliated facilities in Milan. They include Centro Studi Nucleari Enrico Fermi, which is doing research on nuclear energy; the Istituto di Chimica Industriale, basic chemical research; Istituto Ingegneria Sanitaria, health engineering; Istituto di Elettronica-Politecnico, electronics; Stazione Sperimentale della Cellulosa, cellulose fibers; and the Stazione Sperimentale per i Combustibili, combustible materials.

Other major nonprofit laboratories are the Laboratorio Controllo Fumi, a cooperative laboratory engaged in smoke control research; the Centro Ricerche della Commissione Comunita Europee, a European Economic Community (EEC) nuclear energy research laboratory; and Istituto Carlo Erba per Ricerche Terapeutiche, a pharmacological research facility of the nonprofit Carlo Erba Foundation. In addition, there are 113 general research laboratories in the major universities, as well as many facilities used for training scientists, engineers, and technicians.

The research performed by the 19,000 professionals and 10,000 technicians employed in university facilities encompasses a wide scope of topics. Their work, like that being done in the foundation-run laboratories, utilizes most analytical tools, including chromatography, colorimetry, electrometric methods, electromicroscopy, mass spectrometry, nuclear magnetic resonance, particle size analysis, turbidimetry and nephelometry, and spectrometric and X-ray methods. Applications of computer technology are minimal. Only a few laboratories now employ electronic data processing equipment, and most are too small to consider purchase of computers in the future. The large research laboratories could make effective use of minicomputers in the future.

Sales opportunities for sophisticated laboratory instruments are expected in this sector due to enlargement of ongoing research work at the Istituto Fisicontecnico (energy) and the Istituto Microbiologia Agraria e Tecnica (new protein sources), both connected with the University of Milan, and to enlargement of the oceanography studies at the Facolta Chimica Industriale at the University of Venice. Much of the increased demand probably will be related to government-funded expansion in R&D. Although some rise is anticipated in sales of advanced equipment, the bulk of the growth is likely to occur in the small educational laboratories that generally buy low-cost, unsophisticated equipment useful for training purposes.

Laboratories in the fabricated metal products industry.—The vast fabricated metal products industry in Italy comprises over 600,000 manufacturers, a number of which are internationally known companies involved in extensive R&D programs. With 1974 laboratory instrument outlays of $12.8 million, this sector outranks other Italian industries as a consumer of laboratory instruments. Automotive production, the largest industry within this sector, had a 1973 turnover estimated at between $6 and $7 billion. The household appliance industry had sales approaching $1 billion in the same year. Italian firms also are international leaders in production of machine tools, with sales of almost $550 million, plus another $200 million for textile machinery sales.

The approximately 800 laboratories in this sector should spend an estimated $240 million for laboratory expenditures in 1979, up from $148 million in 1974. Instrument purchases are expected to escalate at the average rate of 10.7% annually, between 1974 and 1979.

About 100 large laboratories (with more than 100 employees each) account for about 70% of laboratory instrument purchases. The major facilities are run by such companies as Fiat, Alfa Romeo, Aeritalia, Agusta, Asgen, Ercole Marelli, Nuovo Pignone, Ansaldo, Meccanico Nucleare, and Zanussi.

Fiat's Central Laboratories employ over 400 people in research on chemistry, mechanics, and metallurgy. Major chemical and ecological R&D projects include investigation of lubrication and combustion, electrochemistry, nonpolluting paint and other protective coatings, and industrial pollution control techniques. Areas of applied physics and mathematics research are condensed-state and engineering physics, new techniques for nondestructive controls, cybernetics, electro-acoustics, nuclear energy, and development of applications for new spectrometry techniques. Other areas of research include new alloys, powder metallurgy, ceramics and other materials capable of withstanding drastic environmental operating conditions, plastics, and elastomers.

Fiat also has an engineering research center with 350 employees concentrating on thermodynamics, flow dynamics, internal combustion, and electric engines. In addition, there is a data processing group to evaluate and back up research efforts.

Another large laboratory is operated by Agusta, a helicopter manufacturer. Its 200 employees conduct basic and applied research on aerodynamics, fluid dynamics, vibration, metal fatigue, and materials testing. Computers are employed for simulation of aircraft structure.

Competitive pressures are expanding R&D efforts within the fabricated metal products industry. Fiat is attempting to improve fuel consumption and diminish exhaust emission and is venturing outside the automotive field to reduce reliance on its traditional product line. The aircraft industry also is committed to R&D, with particular emphasis on development of improved fixed- and rotary-wing models. The manufacturers of machine tools and textile machinery are heavily involved in developing larger, faster, and more automated equipment.

The large laboratories employ chromatography, colorimetry, electromicroscopy, mass spectrometry, particle size analysis, and thermal and X-ray methods. Electronic data processing equipment, generally bought separately from the laboratory instruments, is heavily utilized. Minicomputers have been recently introduced and are becoming more popular.

Within this sector there is interest in purchases of the following:

Accelerometers
Air sampling, frequency, gas, noise-level and wave analyzers
Apparatus for testing physical properties of industrial materials
Balances
Centrifuges
Gas chromatographs
Manometers
Electron and optical microscopes
Penetrometers
Potentiometers
Pyrometers
Thermometers
Voltmeters

Laboratories in the chemical industry.—The huge Italian chemical industry is another major consumer of laboratory instruments. Total sales of chemical products are expected to climb at an estimated yearly rate of 15% from the 1974 level of $5 billion to over $10 billion by 1979. Pharmaceutical production is particularly important; with a 1974 output of $1.5 billion and a projected volume of $2.4 billion in 1979, the Italian pharmaceutical industry ranks among the world's leaders.

Laboratory expenditures by the chemical industry are expected to increase from $128 million in 1974 to over $174 million in 1979 as a result of expansion in production capabilities. Annual growth in the purchase of new laboratory instruments is predicted to average 7.5% over the 1974-79 period; outlays for this purpose, over $12 million in 1974, should top $17 million in 1979.

Of the 880 laboratories in this sector, about 100 are large facilities, the instrument purchases of which account for about 80% of the total for this industry. The large laboratories are operated primarily by the few companies that dominate the sector. The Montedison Group, which includes Montefibre (a maker of chemical fibers), Carlo Erba (pharmaceuticals), and Farmitalia (pharmaceuticals), operates 38 research centers, which employ staffs ranging in size from 100 to 500. In all, about 6,000 employees work in R&D at Montedison. The largest of the Montedison laboratories employs 600 people, 200 of whom hold university degrees. The major areas of investigation at these facilities are organic chemicals, electrical research, textiles, electronics, and instrumentation. Antipollution, desalination, and microbiology are additional fields of interest. The projects are aimed primarily at product improvement.

ANIC, another large company in the chemical sector, is a member of ENI Group, the government holding company. ANIC's R&D activities are conducted through SNAM Progretti, an ENI subsidiary. The R&D being conducted for ANIC generally is in the area of product improvement.

SNAM Progretti operates a basic research laboratory for all members of the ENI Group. The laboratory employs about 1,000 people, 300 of whom hold university degrees. R&D at this facility is centered on new energy sources, food preservation, and industrial microbiology. Another SNAM Progetti facility is investigating ammonia stripping for production of urea.

A number of large laboratories operated by Snia Viscosa are investigating synthetic pulp fiber for paper, granular polymides, semifinished plastics, plastics reinforced with glass fibers, and dyes for chemicals and fibers. Synthetic rubber and plastic film are R&D subjects in laboratories of Societa Italian Resine. Liquigas laboratories are working on N-paraffin and olefins, with emphasis on development of synthetic proteins and synthetic citric acid.

Pharmaceutical R&D is also of primary importance in this sector. Recently drugs for treatment of tumors, leukemia, and pyorrhea have been developed, and virtually all areas of pharmaceutical R&D are being pursued at present in this industry. Such research will get additional funds through a new company, Tecnofarmaci. This subsidiary of IMI has been formed to stimulate R&D in small and medium-size pharmaceutical companies.

Virtually every type of analytical technique is employed in laboratories of the chemical industry. Of particular importance are chromatography, colorimetry, electrography, electrometric methods, mass spectrometry, nuclear magnetic resonance, turbidimetry and nephelometry, and spectrometric, thermal, and X-ray methods.

Computers are also becoming important for analytical purposes. Montedison, for example, is using a computer to synthesize the physical properties of organic compounds. Use of minicomputers is becoming more widespread, and a number of laboratories may acquire this type of equipment. Because they prefer to purchase modules rather than systems, end users usually buy the minicomputers separately from the laboratory instruments.

Strong demand is anticipated in this sector during the 1974-79 period for:

Absorption meters
Amino acid, gas, Mossbauer effect, isotope, oxygen, partial pressure, particle size, thermomechanical, thermogravimetric, differential thermal, turbidity, and water analyzers
Balances
Colorimeters
Centrifuges
Gas and high-performance liquid
chromatographs
Microdensitometers
Infrared detectors
Manometers
Mass spectrometers
pH meters
Spectrofluorometers
Spectrophosphorimeters
Infrared, NMR, Raman, and X-ray spectrometers
Tensiometers
Thermometers
Viscometers
X-ray diffractometers

Laboratories in the electronics industry.—The electronics industry as a whole is experiencing a spectacular 20% average annual growth. With predicted 1974-79 expansion at this rate, sales volume in the industry should be between $4 billion and $5 billion by 1979. At the same time laboratory expenditures by these companies are expected to rise from $92 million in 1974 to an estimated $149 million 5 years later, and instrument outlays are projected to increase from $8.7 million in 1974 to $15 million in 1979.

This fragmented industry contains numerous small firms as well as such giants as Olivetti and IBM Italia (both with 1973 sales of close to $500 million), and the government-owned STET Group. Many large companies in other industrial sectors also have electronics subsidiaries. The 500 laboratories serving the electronics industry include about 75 large facilities (with over 100 employees) that account for about 75% of the instrument purchases of the sector.

Electronics laboratories are involved in R&D on telecommunications and data processing, generally from the standpoint of product development, improvement, and quality control. Very little basic research is performed.

Substantial R&D funds have been budgeted for projects such as development of data processing equipment at Olivetti, which is expanding its facility at Ivrea. Work is also underway on solid-state microwave equipment and satellite communications at SIT Siemens, GTE, Face Standard, and Telettra. Selenia is heavily involved in development of radar, computers, air traffic control systems, communications equipment, and automatic controls for power station networks. Elsag is developing automated postal equipment; Nuovo Pignone is doing R&D on electronic industrial control and measuring equipment, process computers, automation, and other remote control apparatus. Interests of smaller companies include tele-indicating equipment and three-dimensional electronic measuring devices.

Analytical tools frequently used in electronics laboratories are chromatography, electron microscopy,

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Italy is available on a continuing basis from:

Country Marketing Manager-Italy
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Italy," DIB 75-05-513, February 1975.

and X-ray methods. Electronic data processing is heavily utilized in this industry because many companies are in the computer business, and the vast numbers of components in complex electronic products require use of the computer in product design. End users are oriented toward large computers, and there is a preference to buy or rent the data processing equipment separately from laboratory instruments. Minicomputers are expected to become popular in the future.

Research in this sector is creating demand for test and measuring instruments such as:

Ammeters
Analog signal correlators
Capacitance measuring equipment
Digital scopes
Dielectric measuring equipment
Electron probe analyzers
Multimeters
Oscillometers
Oscilloscopes
Signal generators
Digital-type voltmeters
Wave analyzers

Trade and Technical Regulations

U.S. manufacturesr will find demand for their technologically sophisticated products in spite of tariffs, which range from 6% to 13%. Producers from original EEC countries have a tariff advantage in Italy, since their laboratory instruments are not subject to customs duties, and soon new EEC member states will be joining this privileged. group. Higher equipment prices, however, do not exclude other makers of high-quality equipment from the Italian market. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

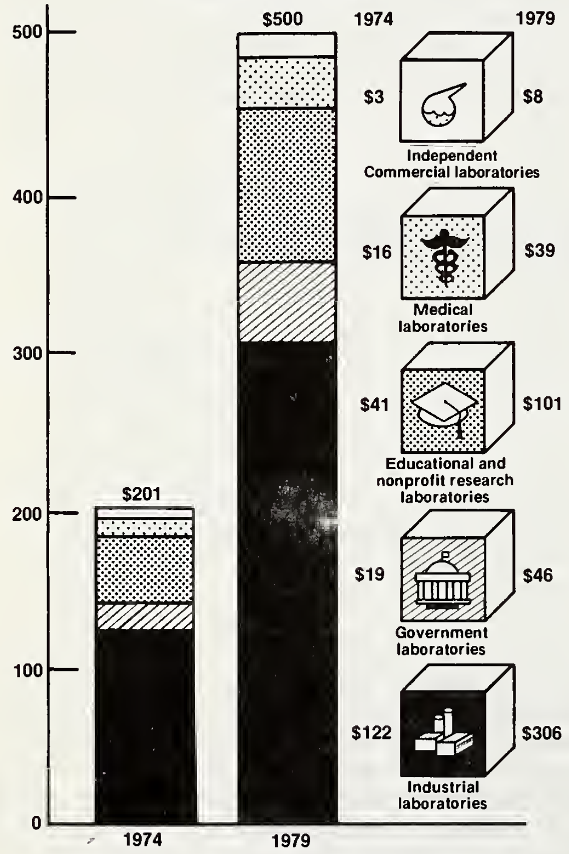
Electrical supply in Italy is normally 380/220 volts, 3-phase, 4-wire, 50-cycle. The country uses the metric system of weights and measures.

There are no special Italian technical standards that apply to imported products. Additional information on this subject may be obtained through the American National Standards Institute, Inc. 1430 Broadway, New York, New York, 10018.

Japan

Demand for new energy saving products coupled with consumer pressure for better quality is focusing attention on the shortage of laboratory facilities in Japan. As Japan tries to modernize and expand its laboratories, the market for instruments is expected to reach $500 million[1] in 1979. (see figure 1). Sales grew from $134 million in 1972 to over $200 million in 1974 and were estimated at more than $240 million in 1975 (see table 1).

Figure 1. **Japan: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)**



Source: Bureau of International Commerce, Office of International Marketing research report. Values based on Japanese trade source estimates.

Growing interest in the development of superior chemical and metal products, and consumer demand for higher quality in processed foods and a greater variety of frozen food is encouraging these Japanese industries to improve their research and evaluation facilities. Investments in instruments expected to accompany the expansion of industrial laboratories, will help push purchases of laboratory instruments by this sector to over $300 million in 1979.

Sales of laboratory instruments to educational and non profit research laboratories are forecast to grow by 20% annually from $41 million in 1974 to over $100 million in 1979. The Ministry of Education is attempting to upgrade educational standards by increasing funds available to colleges and universities. Some of the increased expenditures are expected to be used to purchase laboratory instruments.

Government laboratories are expected to purchase instruments valued at $46 million in 1979, a substantial rise over the $19 million spent in 1974. During the same time period sales of instruments to medical laboratories rose from $16 million to nearly $40 million, for an average annual growth rate of nearly 20%. Although comparatively few in number, independent commercial facilities are important purchasers of instruments. Sales to this sector are expected to grow from $3 million in 1974 to $8 million in 1979.

Competitive Environment

While domestic manufacturers are the predominant suppliers of laboratory instruments, imports fill the need for highly sophisticated instruments. Foreign sales

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = yen 308 (1972), yen 272 (1973), and yen 290 (1974 and subsequent years).

Table 1.—Japan: Size of market for laboratory instruments, 1972, 1974, and estimated 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	186	263	315
Imports	22	39	47
Exports	74	101	121
Market size[1]	134	201	241

[1] Market size equals production plus imports minus exports.

Source: Values based on estimates by the Japan Analytical Instruments Manufacturers' Association (JAIMA), Japan Measuring Instruments Industrial Federation (JMIIF), and Japan Flow Meter Industry Association.

of laboratory instruments, which amounted to over $39 million in 1974, are expected to continue to increase by an average of 20% annually to $98 million in 1979.

The United States is the unchallenged leader in the import market (see table 2). The U.S. share 53% in 1972, was estimated to have grown to 58% in 1974. This share is expected to be maintained through 1979 When U.S. sales may exceed $56 million. Trade sources are confident that American preeminence will continue because of the U.S. reputation for continuously innovative technology (particularly in computer interfacing).

Major American suppliers of laboratory instruments include the following: E.I. du Pont de Nemours & Co., making liquid chromatographs, mass spectrometers, electron spectrophotometers, and thermal analyzers; General Electric Company, equipment for X-ray analysis and radioactive measurement; Finnigan Corporation, energy-dispersive X-ray spectrometers and gas chromatographs; Perkin-Elmer Company, gas and liquid chromatographs and atomic absorption spectrophotometers; G.K. Turner Associates, spectrophotometers, fluorometers, and spectrofluorometers; Hewlett-Packard Company, gas chromatographs; Westinghouse Electric Corporation, radiation detectors; and Bausch and Lomb, spectrophotometers.

U.S.-designed equipment is also supplied by American subsidiaries operating in Japan. Four leading Japanese-American joint ventures are Beckman-Toshiba, Ltd. (50% owned by Beckman Instruments, Inc.); Nippon Electric Varian, Ltd. (49% owned by Varian Associates); M.S.A. Hokushin Ltd. (50% owned by Mine Safety Appliances Company); and Nippon Jarrel-Ash Company, Ltd. (33.3% owned by Fisher Scientific Company). The domestic industry supplies 80% of the laboratory instruments needed in Japan, including almost the entire market for electron microscopes, X-ray and thermal analyzers, densitometers, gas chromatographs, and pH meters (see table 3).

The Japanese Government is eager to promote industries that can produce internationally competitive, high value-added commodities without consuming great quantities of natural resources. Laboratory instrument manufacture falls into this category and is viewed as important in contributing to Japan's future growth. Expansion in the industry depends heavily on exports. Keen competition in technical quality on the world market, plus Japan's rate of inflation will make such expansion difficult; nonetheless, exports are expected to grow by nearly 20% annually between 1974 and 1979 totaling over $250 million in 1979.

Government research organizations are required to purchase locally made instruments except when suitable domestic equivalents are unavailable. Trade sources expect this "Buy-Japanese" practice to increase among private sector purchasers as quality and reliability increase.

Japan's Government supports domestic production of laboratory instruments by providing some R&D funds to develop more advanced laboratory instruments. However, as of 1973 a total of only $2 million had been spent to subsidize these research projects.

The two leading laboratory instrument manufacturers in Japan are Shimadzu Seisakusho Ltd. and Hitachi, Ltd. Under licensing arrangements with American firms, Shimadzu Seisakusho produces electron microscopes (by agreement with RCA); analytical instruments (Applied Research); liquid chromatographs, gas/liquid analyzers, and fluorescence photometers (E.I. du Pont); and biological/medical/industrial nucleonic instruments (Nuclear Chicago Corporation). By agreement with L.K.B. Produkter AB of Sweden, Shimadzu produces gas chromatographs. Hitachi Ltd. also has licensing agreements to produce electron microscopes (RCA); nuclear magnetic resonance (NMR) spectrometers (Perkin-Elmer); and scanning electron microscopes and electron energy analysis equipment (Dr. Albert V.C.). A third important manufacturer, JEOL Ltd., produces electron microscopes under license with RCA and IBM, and the company produces NMR spectrometers under license with Varian Associates. Two other major companies are Horiba, Ltd. and Rigaku Denki Company, Ltd. In addition, Jasco Syntex Co., Ltd. is a 50/50 joint venture of Japan Spectroscopic Ltd. with Syntex Analytical Instruments Corporation of Panama.

Firms from West Germany, Sweden, Ireland, Switzerland, and the United Kingdom together supply somewhat less than 35% of the import market for laboratory instruments in Japan. They predominate in supplying balances and provide a significant proportion of photometric/spectrophotometric and electrochemical analyzers. German optical instruments have a worldwide reputation for quality, which helps to account for their popularity in Japan. British firms active in the market credit their success to training of their sales and service personnel. A trade exhibit featuring analytical and pollution control instruments by 11 U.K firms in Tokyo in November 1974 also proved to be a successful promotion venture.

A particularly well-established West German firm is Carl Zeiss, which has a subsidiary of the same name in

Japan and markets a wide variety of photometric/spectrophotometric analyzers and microtomes. Pye Unicam Ltd. of the United Kingdom, which supplies liquid and gas chromatographs and atomic absorption spectrophotometers, is also very active in the Japanese market.

L.K.B. Produkter AB sells gas chromatographs and mass spectrometers. Another Swedish firm, AB Atom, provides nucleonic instrumentation, as do other enterprises, e.g., Inter Technique of France and Nuclear Enterprises and Koch-Light Laboratories, Ltd., both of the United Kingdom.

Selected instrument markets.—Research recently conducted in Japan for the Office of International Marketing, Bureau of International Commerce, surveyed 15 instruments considered important in the market. The market for *liquid chromatographs*, almost $9 million in 1974, is expected to grow more than 30% annually to exceed $32 million by 1979, largely as a result of the popularity of the high performance liquid chromatograph (HPLC). The detecting range of HPLC's has been much improved by the use of an ultraviolet (UV) spectrophotometer and a fluorescence spectrophotometer. U.S. firms supplied 20% of the market in 1974, while domestic firms provide 75%. Major Japanese manufacturers of HPLC's include Kyowa Seimitsu K.K., Toyo Soda Kogyo K.K., Nishio Kogyo K.K., Japan Spectroscopic Co., Ltd., Nippon Bunseki Kogyo K.K., Hitachi Ltd., Mitsumi Kagaku Sangyo K.K., and Yanagimoto Manufacturing Co., Ltd. Varian Aerograph, Perkin-Elmer, and Pye Unicam Ltd. also participate in the market.

The market for *mass spectrometers*, $10 million in 1974, is growing at an average 20% annual rate and is expected to exceed $25 million by 1979. In addition to conventional magnetic-field sweeping types, instruments featuring polar electric fields have become popular as detecting units for gas chromatographs and residual gas analyzers. Chemical and field ionization and field desorption methods have been replacing the conventional electron impact methods.

Of the nine local suppliers, Kokusai Electric, JEOL, Ltd., and Hitachi, Ltd. are the leaders. American firms, led by Avco Corporation and E.I. du Pont accounted for 25% of sales in 1974. Third-country firms include L.K.B. Produkter.

Sales of *NMR spectrometers* are also growing at an average 20% annual rate and are expected to rise from less than $9 million in 1974 to almost $22 million in 1979. American manufacturers supplied 40% of the market in 1974. Nippon Electric Varian, Ltd., JEOL, Ltd., and Hitachi, Ltd. were the principal local manufacturers as well as import distributors.

The trend in NMR spectrometers is toward a more easily operated compact unit. Also being marketed is a 8139C-NMR analyzer which interfaces an NMR spectrometer with a Fourier transformation unit.

Domestic manufacturers provide 60% of the *balances* sold in 1974 while Swiss and German firms were the leaders in the import market. Sales are expected to increase from $5 million in 1974 to $13 million in 1979. Most balances marketed are of the digital face type with a facility to measure net weight which minimizes operator error.

Table 2.—Japan: Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Apparatus for spectroscopic analysis (non-illuminating)			
United States	376	438	268
West Germany	57	25	6
Other	1	14	17
Total	434	477	291
Gas analyzers			
United States	107	139	69
Germany	53	71	59
United Kingdom	6	8	3
Other	29	12	1
Total	195	230	132
Laboratory instruments and apparatus for physical or chemical analysis			
United States	777	1,290	266
Sweden	22	63	41
Germany	44	49	27
United Kingdom	17	29	27
Other	29	67	25
Total	889	1,498	386
Electrical analyzing apparatus			
United States	9,355	14,735	9,886
Ireland	2,003	3,150	1,525
Sweden	861	1,253	355
United Kingdom	753	1,203	912
Other	1,567	2,752	1,101
Total	14,539	23,093	13,779
Electromagnetic analyzing apparatus			
United States	353	827	215
United Kingdom	45	121	10
Germany	9	29	27
Other	359	24	—
Total	766	1,001	252

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[1] January through June.

Source: Ministry of Finance, 'Japan Exports and Imports,' December 1972 and 1973 and June 1974.

Shimadzu Seisakusho Ltd, Cho Keiryoki K.K., and Kensei Industrial Co., Ltd., are major manufacturers in Japan. Mettler Instrumente A.G. of Switzerland and Sartorius-Werke GmbH of West Germany are well-established suppliers. Du Pont instruments are also imported, but in smaller quantities.

The market for *oxygen analyzers*, which totaled $10 million in 1974, is expected to reach almost $26 million in 1979. The American share 15% in 1974, is expected to drop slightly as local production raises the domestic share from 80% to 85% by 1979.

Many Japanese companies manufacture various kinds of oxygen analyzers. Shimadzu Seisakusho Ltd. and Mitaka Kogyo K.K. produces both magnetic and galvanic-cell types, while Beckman-Toshiba, Ltd. makes magnetic and polarograph types. H. Maihak of West

Table 3.—Japan: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatographs	17,24	,86	.35	16.03	34.5	1.7	.7	32.1
Liquid chromatographs	8.62	1.72	.43	6.47	32.1	6.4	1.6	24.1
Mass spectrometers	10.35	2.07	.52	7.76	25.9	5.2	1.3	19.4
NMR spectrometers	8.62	3.45	—	5.17	21.6	8.6	—	12.9
pH meters	6.90	.35	.14	6.41	17.2	.9	.4	16.0
Densitometers	2.07	.04	.04	1.99	5.2	.1	.1	5.0
Thermal analyzers	5.86	.59	.29	4.98	14.7	1.5	.7	12.5
Electron microscopes	13.79	.04	.03	13.72	34.5	.1	.1	34.3
X-ray analyzers	24.14	.05	.24	23.85	60.4	.1	.6	59.6
Balances	5.17	.26	1.81	3.10	12.9	.7	4.5	7.8
Oxygen analyzers	10.35	1.55	.52	8.28	25.9	2.6	1.3	2.0
Photometric/spectrophotometric analyzers	58.62	8.79	5.86	43.57	129.3	12.9	6.4	110.0
Ultracentrifuges	3.45	.69	.17	2.59	6.9	1.4	.4	5.2

Source: Data based on estimates by JAIMA and the Ministry of International Trade and Industry (MITI).

Germany sells oxygen analyzers and oxygen deficiency monitors. Taylor Servomex, Ltd. of the United Kingdom and Bio Marine Industries and Lexington Instruments Corp., both of the United States, are also represented in the market.

Photometric and spectrophotometric analyzers represent the largest market for laboratory instruments surveyed. Sales growing at a 17% average annual rate, should rise from $59 million in 1974 to $129 million by 1979. American manufacturers, including Perkin-Elmer and Varian Techtron, satisfied 15% of demand in 1974; third-country firms, led by Pye Unicam of the United Kingdom, supplied 10%. The domestic share is expected to increase from 75% to 85% between 1974 and 1979 at the expense of both groups of importers. Of the 10 local manufacturers making ultraviolet, visual, atomic absorption, and Raman spectrophotometers, five also make infrared (IR) spectrophotometers.

The market for *ultracentrifuges*, including accessories and peripheral equipment, is relatively small; demand is expected to grow steadily, and sales should rise from $3.5 million in 1974 to $6.9 million by 1979. The market is dominated by Japanese manufacturers, such as Beckman-Toshiba, Ltd. and Hitachi, Ltd. American firms, led by International Equipment Corp., satisfied 20% of the demand in 1974, while third-country firms, including Measuring and Scientific Equipment Ltd., of the United Kingdom, provided 5%.

Major Purchasers

R&D expenditures in 1973 exceeded $8 billion (see figure 2). About 90% or $7.3 billion was spent on research in the physical, engineering, and life sciences. Nearly $1 billion of the R&D funds went to purchase labor atory machinery, utensils, and equipment, including instruments.

R&D funds are forecast to reach nearly $19 billion in 1979 representing expansion on the average of 15.5% annually from 1973 to 1979. Industry, which spent $4.9 billion in 1973, has allocated over $11 billion for 1979. Expenditures by educational and nonprofit institutions are expected to rise from less than $2.6 billion in 1973 to more than $6 billion in 1979.

Prior to 1973 there was little flow of funds from the Government to the private sector. In 1972, 97.4% of the funds spent by the industrial sector came from its own internal sources, and 2.6% from government subsidy. As for government laboratories, 97% of total expenditures were financed by national and local governments. Public universities and colleges received nearly 99% of their R&D funds from the Government while private educational institutions got 10% of their R&D funds from the Government. In 1973, however, in an effort to speed reorientation of the industrial structure toward less resource-consumptive activities, the Government increased its subsidy to private R&D facilities to $415 million; this represents a 37% increase over the subsidy for the previous year.

Research scientists in the physical, chemical, and other life sciences as of 1972 exceeded 126,000, representing 56% of the total number of scientists. In addition there were almost 89,000 engineers and technicians working in the life sciences (see table 4). Educational and other nonprofit institutions employed over 44% of the natural scientists, followed by industry with 42%, government laboratories with 13%, and independent commercial facilities with less than 1%.

More than 9,000 persons were studying the natural sciences and engineering in foreign countries in 1973. Almost half were in the United States, 2,800 in Europe, and 1,700 in other parts of Asia. Of the 40 persons sent abroad in 1974 by government laboratories annually for long-term overseas study, 22 went to the United States.

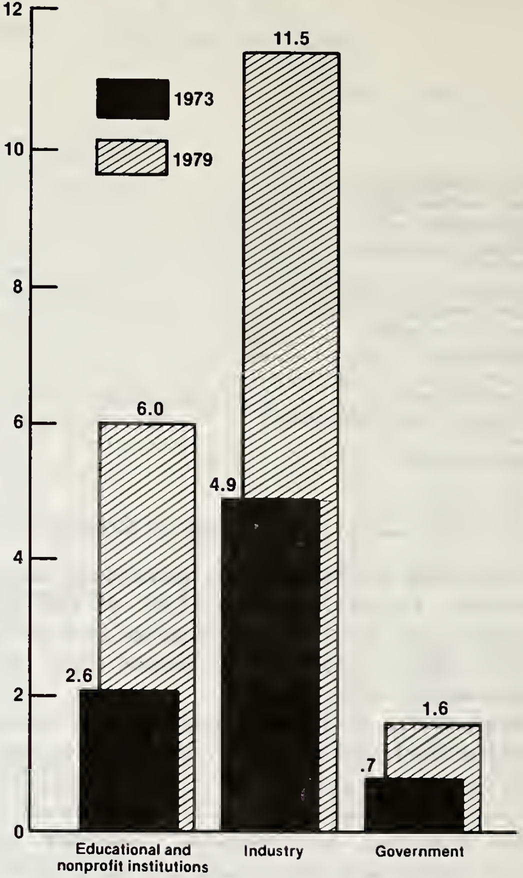
Laboratories in the chemical industry.— The Japanese chemical industry is one of the largest in the world. Japan is second only to the United States in production of plastics, sulfuric acid, and caustic soda, and trails only the United States and the Soviet Union in nitrogenous fertilizer production. The rapid expansion of production achieved in the early 1970's, is expected to slow-down to a rate of 7% annually between 1975 and 1980. Exports are expected to continue to rise throughout the late 1970's—especially dyestuffs, printing inks, and pollution-proof chemical products. Planned capital expenditure of the petrochemical industry for 1974 was $1.1 billion. Investment, which had dropped in 1971 and 1972, greatly increased in 1973 and 1974. However, future expansion appears to be limited by the general economic situation and the difficulty of finding suitable sites for plant construction within Japan.

Laboratories in the chemical industry spent $25 million on instruments in 1974. An estimated 64% of all laboratory expenditures in the industry were accounted for by the 52 large companies staffed with 100 or more regular researchers. Of the 26,000 researchers working in all of the chemical industry laboratories, over 18,000 were chemists. Half of the chemists worked with industrial chemicals; the remainder did research in oils and paints, drugs, medicines, and other chemicals. Approximately 3,400 of the researchers were pharmacists, 1,000 were in assorted agricultural disciplines; 900 were biologists; 800 were mechanical, shipbuilding, or aircraft engineers; 750 were textile engineers; and 1,150 were in other disciplines.

A major R&D target in this industry is the recycling of plastics and industrial wastes. Future technological goals include experimentation with the performance of chemical substances under extreme conditions and the study of excessive pressure. The latter effort encompasses investigation of the use of pressure as a source of energy, production of new synthetic superhard materials and special semiconductors, and the possibility of nonpolluting chemical processing through the use of low temperature and high pressure. The industry is also working with the Government toward a new technology that could lead to discovery of phenomena through which energy conversion could be achieved by natural means rather than by use of artifically contrived high pressure and temperature.

In the chemical, petrochemical, and petroleum refining industries combined, almost 200 minicomputers were in use in 1973. Of these, 66 sets were for interfacing with laboratory instruments. In general, interfacing of laboratory instruments with minicomputers is becoming increasingly common in Japan. At present, complete system sales account for no more than 30% of the total, but the trend is toward increased purchases of complete systems.

Figure 2. Japan: R & D expenditures 1/, 1973 and 1979
(in billions of U.S. dollars)



1/Represents expenditures on R & D performed in the designated sectors, regardless of original source of the funds.

Source: Bureau of Statistics, Office of the Prime Minister, "Interim Report on the Survey of Research and Development in Japan," 1974.

Laboratories in the primary metals industry.—Expenditures for laboratory instruments in this industry reached $10 million in 1974 and are expected to rise to $26 million by 1979. The 10 top companies, which employed more than 100 researchers each, accounted for more than 75% of total laboratory expenditures in 1972. Among the almost 5,500 researchers in the primary metals industry, the largest disciplines represented were mining and metallurgical engineering, 1,800; chemistry, 1,300; mechanical, shipbuilding, or aircraft engineering, 900; electrical or telecommunications engineering, 600; mathematics and physics, 500; civil engineering or architecture, 250.

Steady growth is expected in the iron and steel sector. Crude steel production reached almost 120 million metric tons (MT) in 1973, with exports consuming nearly 29%. The Ministry of International Trade and Industry expects output to exceed 11.2 million MT by 1980, of which nearly 28% will be exported. Capital expenditures exceeded $2.2 billion in 1973, and a 40% increase was planned for 1974.

The industry is undertaking several major R&D activities. Having found high-tensile steel of 50 to 100 kilograms per square millimeter (kg/mm^2) valuable in cutting steel consumption in shipbuilding and bridge construction, the industry is working now to develop a 250 to 300 kg/mm^2 type to further minimize consumption. Other developing technology includes reinforce-

Table 4.—Japan: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1972

	Scientists			
	Physics	Chemistry	Other life	Engineers and Technicians
Employed by:				
Government	1,030	2,850	12,336	10,633,819
Industry	7,051	36,799	8,936	65,090
Educational and nonprofit institutions	7,333	6,749	42,513	13,134
Independent commercial facilities	102	289	646	NA

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[1] Includes figures for nonprofit institutions and independent commercial facilities.

Source: Data based on "Report on the Survey of Research and Development in Japan, 1973," Bureau of Statistics, Office of the Prime Minister, published 1974.

ment of metals through cladding and whisker research. Niobium has replaced nickel in steel alloys to produce a better quality pipeline for use in low temperatures. Aluminum has already replaced copper in more than 20% of the electric power cables produced in Japan, and the increasing substitution of aluminum for copper in other areas is a major goal. With the aid of a government subsidy, the industry is attempting to use a nuclear reactor in the manufacture of steel. The process involves using the heat of helium, a coolant in the multipurpose high-temperature gas cooling reactor.

As of 1972, there were 145 minicomputers in use in the iron and steel sector, 48 of them interfaced with laboratory instruments. Sales of minicomputers for interfacing with measuring and analytical instruments rose from 8 in 1972 to 16 in 1973.

Laboratories in the food products industry.—The food industry is expected to be a leader in Japan's economy in the latter half of the 1970's. Sales in the industry totaled about $29 billion in 1973 and capital expenditures exceeded $1.2 billion. The industry consists of 87,000 companies, 97% of which are small firms employing fewer than 100 workers. Nearly 120 large firms (those with more than 500 employees) are responsible for a sizeable share of total production, and further concentration within the industry appears probable.

Sales of laboratory instruments to this industry amounted to $3 million in 1974. Of the 5,120 researchers employed in all the laboratories, about half were chemists; other major disciplines represented were animal husbandry/veterinary science and agriculture/forestry, 700 each; biology, 450; fishery research, 225; pharmacology, 150; and engineers, 190. Only 3 of the 1,250 companies engaged in R&D in the industry, employed more than 100 researchers.

Frozen food production, particularly seafood and dairy items, has been growing about 30% annually in recent years. The frozen food sector, traditionally labor-intensive, intends to become automated and to increase the variety and number of items produced. R&D goals also emphasize providing safer foods through precise measurement and inspection of toxic substances. Standards will be established to define the tolerable limits for toxic materials in food. The development of automatic analyzers for toxic materials with minimum analysis time is considered important. Irradiated foods will be more widely marketed through developments in the use of enzymes and bacteria in food processing. Large-scale cultivation of fish, seafood, and seaweed is also being studied.

Government laboratories.— Government-sponsored research on the federal level is conducted by laboratories of the government, special corporations, and the national universities and colleges. Projects range from basic research looking toward technological breakthroughs in space to applications of science to public health problems. Government laboratories spent $323 million in 1973, while special corporations received government grants of $336 million and national educational institutions received $43 million. Approximately $28 million (a 41% increase over the preceding year's funding) was spent in 1973 on more than 250 special projects—including nuclear and atomic energy research, weapons development, food and drug safety research, and development of standards.

The numerous government testing and evaluation laboratories are also important potential purchasers of instruments, particularly those applicable to research on foodstuffs; drugs and chemicals, including agricultural chemicals; radioactive substances; water, air, and soil pollution; and safety testing of materials such as metals and macromolecule compounds.

Of the 104 national government research institutes, the 31 large ones with 100 or more researchers accounted for 75% of laboratory instrument purchases in 1972.

National and local government organizations employed about 20,000 researchers; 7,000 worked in agriculture and forestry; 3,500 in chemistry; 1,600 as fishery specialists; 1,600 as mechanical, shipbuilding, or aircraft engineers; 1,500 as animal husbandry and veterinary specialists; 950 as mathematicians and physicists; 850 as textile researchers; and the remainder in miscellaneous fields.

Government agricultural and forestry institutes primarily employ spectrometric, X-ray, and radiometric methods, chromatography, polarimetry, spectropolarimetry, and electron microscopy in their analysis. Some typical projects involve research on the

Table 5.—Japan: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Laboratory expenditures		Purchases of laboratory instruments	
	1974	1979	1974	1979
Government	565	1,531	19	46
Educational and nonprofit institutions	1,117	3,019	41	101
Independent commercial laboratories	73	198	3	8
Medical organizations	663	1,791	16	39
Industry:				
Oil and gas extraction[1]	30	81	1	2
Food products	117	353	3	8
Chemicals	890	2,405	25	61
Petroleum	66	180	2	5
Rubber and plastic products	65	174	3	7
Stone, clay, and glass	99	267	3	7
Primary metals	270	727	10	26
Fabricated metal products	83	223	2	5
Transportation	732	1,978	28	71
Other	2,302	6,222	45	114
Total	7,072	19,149	201	500

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[1] Includes other mining industries such as coal, nonferrous and ferrous metals, light, rare, and precious metals.

Source: Data based on "Report on the Survey of Research and Development in 1973." Bureau of Statistics, Office of Prime Minister, published May 1974.

causes of epidemic diseases among cattle and pigs; methods to improve agriculture and cattle raising in cold climates; research on mulberry trees and silkworm diseases; and removal of residual chemicals from agricultural products.

Government health institutes employ radiometry, mass and NMR spectrometry, electron microscopy, polarimetry, and spectropolarimetry. Research subjects of interest to these organizations include epidemiology, genetics and family planning, treatment of diseases caused by water and air pollution and toxic substances in foods, and safety of pharmaceutical agents and food additives.

The national metals research institute uses radiometric methods, electron microscopy, and X-ray analysis in projects involving underwater welding, high-tensile structural steel development, and heat-resistant steel for reactors. Defense research institutes primarily employ radiometric methods in basic studies relating to firearms, warships, communications, and electric power equipment.

Government industrial research institutes use chromatography, electron microscopy, NMR and other spectrometric methods, electrophoresis, and thermal and X-ray analysis. Research projects are widely varied, ranging from development of electric automobiles and fireproof ceramic construction materials to improving data-processing technology.

Federal government organizations in 1972 were using 58 minicomputers interfaced with laboratory instruments. Local government laboratories had 41 minicomputers in similar use. In addition to acting as a subsidizer of some research in the private sector, the Government recently established the Research Development Corporation of Japan (RDCJ). One of its functions is to let contracts to produce and market new products developed in government and educational laboratories. The company that obtains the bid to produce and market a given item developed by government research reimburses RDCJ for R&D funds only when the product has proved successful on the market. As of March 1974, after the establishment of the RDCJ, 73 out of 79 subsidized products had been successfully marketed.

Educational and nonprofit research laboratories. Total laboratory expenditures in 1974 exceeded $1.1 billion, and are predicted to reach $3 billion in 1979. The 380 Japanese universities and colleges with research facilities are staffed with 35,500 researchers. Special corporation research institutes employed 1,300 researchers; only 6 out of the 26 institutes had more than 100 researchers. By discipline, the major groups of employees in both educational and corporation laboratories include 6,750 mathematicians and physicists; 6,300 chemists and an equal number of mechanical, shipbuilding, or aircraft engineers; 4,400 electrical or telecommunication engineers; 3,400 civil engineers or architects; 2,800 agriculture and forestry specialists; 1,500 biologists; and 1,300 mining and metallurgical engineers. At the University of Tokyo's Institute of Space and Aeronautical Science, a research satellite project uses radiometric methods in working on an electric guidance launching system. Other research includes studies of solar wind energy. The Institute uses X-ray microanalyzers in experiments with heat-resistant materials and radiometric methods in its research on acoustical emissions of plastic deformation. The University of Tokyo's Institute of Medical Science uses chromatography, electron microscopy, radiometric and X-ray methods in research on molecular biology, genetics, immunity, and allergy. The Tohoku University metals research institute works with NMR spectrometers in its study of magnetic semiconductors, superconducting compounds, amorphous metal hardness and deformations, and high-pressure, solid-state physics. The Japan Atomic Energy Research Institute at Tokai employs electron microscopy in its development of reactors and research on fuels for nuclear power plants. The Takasaki Radiation Chemistry Research part of the Atomic Energy Research Institute uses electron microscopy and EPR instruments in applied radiation chemistry. The Institute of Physical and Chemical Research at Hirosawa uses chromatography, electron microscopy, radiometric, spectrometric, thermal, and X-ray methods in wide-ranging basic chemical, physical, and life science research. As of 1972, educational organizations were using 90 minicomputers in their laboratories. Other nonprofit scientific research organizations were using nine minicomputers interfaced with laboratory instruments.

Medical laboratories—Medical laboratories' expenditures amounted to a total of $663 million in 1974 and are expected to reach $1.8 billion by 1979. Some of the principal laboratories are performing research of the toxicity of drugs, rheumatism and cancer; the effect of cadmium on the human body; the chemical and surgical treatment of tuberculosis; germ antigen, virus antigen, immunity and antihistamines; and cholera bacillus. The Cancer Institute uses chromatography, electron microscopy, and spectrometric methods in its basic research on diagnosis and treatment of cancer. The Kitasato Institute uses electron microscopy and NMR instruments to study germ and virus antigens, immunity, and anticancer agents. The Kagaku Ryoho Kenkyusho (Chemotherapeutic Institute for Medical Research) uses electrometric and spectrometric methods to study antigen-antibody reactions.

Independent commercial facilities laboratories.—The 143 commercial research institutes spent $73 million for their laboratories in 1974. Almost 1,300 researchers were working in these facilities in 1972. The largest discipline represented chemistry with 265 staff members; civil engineering or architecture, 190; and electrical or telecommunication engineering, 160. Large laboratories in this sector are studying the durability of aluminum under varying conditions, methods of measuring performance of optical lenses and three-demensional color-image systems; and treatment of sewage. Laboratories in this sector had 12 minicomputers interfaced with laboratory instruments in 1972.

Trade and Technical Regulations

Except for electron microscopes, which have an 8% tariff rate, import tariffs on laboratory instruments imported from the United States, are assessed of the price, plus insurance and freight. Over 100 developing countries, including all members of the United Nations Conference on Trade and Development, enjoy either complete or partial exemption from import duties. No import licenses are required for laboratory instruments.

Further details concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230. Information on industrial standards are published annually in the Japanese Industrial Standards Year Book by the Nippon Kikaku Kyokai (Japanese Standards Association) 1-24, Akasaka 4-chome, Minato-ku, Tokyo 107, Japan. Information on the availability of published standards for laboratory instruments in Japan may also be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York, 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Japan is available on a continuing basis from:

Country Marketing Manager-Japan
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

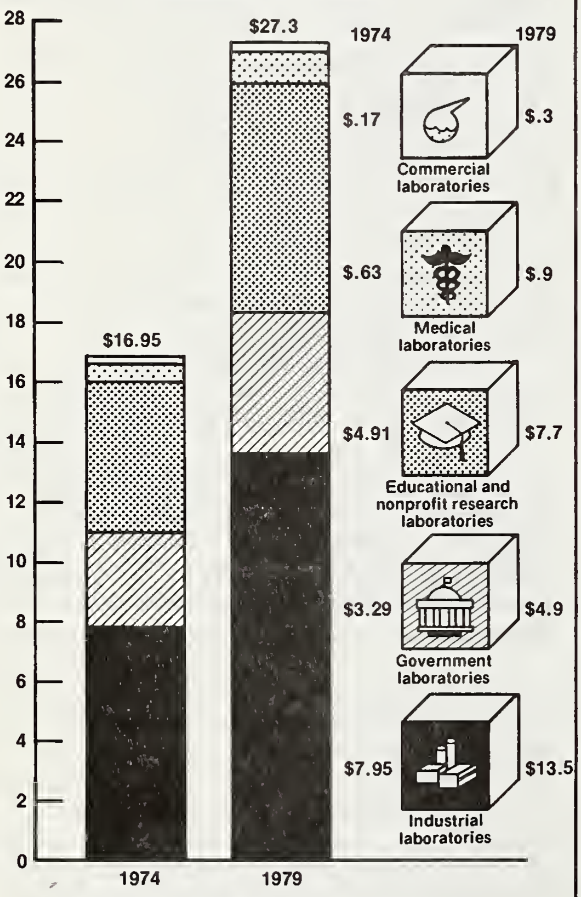
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Japan," DIB-09-502, March 1975.

Mexico

The Mexican Government is attempting to alter the country's traditional dependence on foreign technology through enactment of legislation designed to encourage domestic research and development (R&D)efforts. As a result, an increasing number of companies, schools, and government agencies are entering the laboratory instrument market. Estimated consumption for 1975 is nearly $19 million[1] (see table 1). Instrument purchases rose an average 28% annually, from more than $10 million in 1972 to almost $17 million in 1974, and should exceed $27 million in 1979.

Figure 1. Mexico: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report; values based on Mexican trade source estimates.

Industrial firms account for nearly half of the market (see figure 1). Educational and other nonprofit institutions use these products in both research and training facilities; their 1979 purchases are expected to be half again as much as the $4.9 million spent in 1974. The third largest consumer group, government laboratories, is forecast to expend nearly $5 million in 1979 for instruments to support research, especially in fishing and agriculture and medicine and public health.

Competitive Environment

Mexican laboratories buy 85% to 90% of their instruments from foreign manufacturers. U.S. firms supplied $10.7 million of the $16.7 million import market in 1974 and are expected to account for 64% ($17 million) of the laboratory instrument imports in 1979. A major factor in the preference for U.S. instruments is their technical superiority, a prime concern of Mexican end users. The desirability of American products is further enhanced by past performance records and continuous product development; proximity assures facility in obtaining spare parts and service.

Most of the numerous U.S. suppliers active in the Mexican market offer a variety of laboratory instruments. Many firms have established sales subsidiaries to facilitate trade. The leading subsidiaries are Perkin-Elmer de Mexico, S.A., Beckman Instruments de Mexico, S.A., Hoffman-Pinther de Mexico, S.A. (a subsidiary of American Hospital Supply), and Hewlett-Packard de Mexico, S.A. de C.V.

Third-country competition is not great. German manufacturers supplied 15% of the import market in 1974; Japanese firms provided 5%. While U.S.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = 12.5 pesos.

Table 1.—Mexico: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	1.47	1.82	2.0
Imports	9.51	16.72	18.4
Exports	.62	1.59	1.7
Market size[1]	10.36	16.95	18.7

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[1] Market size equals production plus imports minus exports.

Source: Values based on Mexican trade source estimates.

manufacturers are the principal suppliers of the major product lines. German firms dominate in some areas—microscopes, balances, aerometers, densitometers, and saccharimeters are among the most important. While Zeiss' reputation for quality and high technology in microscopes is the major reason for German supremacy in this product area, price has been the main determinant to success in sales of German-made balances. Other firms from Germany selling in Mexico include Wielder, Lietz, and Souter.

Price appears to be the major factor for preference of Japanese products, although HERMA polarimeters, sold through Hitachi de Mexico, are noted for their technical superiority. Japanese firms such as Rosva-Olympus and Erma supply 80% of the polarimeters, 65% of the compound microscopes, and 61% of the refractometers sold in Mexico; they are also very active in providing multimeters and oscilloscopes. Philips of the Netherlands is another leading supplier of laboratory instruments.

Only thermometers and simple microscopes are manufactured in Mexico. Production of these items rose from $1.4 million in 1972 to $1.8 million in 1974 and is predicted to increase about 10% annually to nearly $3 million in 1979. The two companies that make up the domestic laboratory instrument manufacturing industry are both foreign subsidiaries. Taylor Instruments de Mexico, S.A. produces thermometers and distributes other types of laboratory instruments from its parent firm in the United States. Thermometers account for 4% ($35,000 in 1974) of Taylor's sales each year. The company expects income from these instruments to increase from 10% to 15% annually through 1979.

Carl Zeiss of Germany manufactures microscopes of up to 2500 power in Mexico. Its sales reached $1.8 million in 1974 and are expected to grow 10% to 12% during the 1974-79 period; microscopes account for about 25% of total sales. Zeiss sponsors student and new-graduate seminars in which its products are introduced and demonstrated. Consequently, the use of Zeiss equipment in schools is very high.

The Government encourages domestic production primarily through tax incentives and protective tariffs, which were revised upward several times in 1974. The effectiveness of this approach depends to a great extent on Mexican industry's willingness to conform to the program and its ability to develop the required technology. Some subsidiaries and licensees of U.S. and other foreign companies already import parts and assemble instruments in Mexico. American Optical plans to construct for microscope production. The necessary permits were obtained in January 1975, and these products should reach the market by the end of the year.

The Government is also promoting exports of some laboratory equipment. As of mid-1975, all exports were reexports, mainly from U.S. sales subsidiaries. Zeiss intends to start selling to Canada and other parts of Latin America during 1975 and hopes to export as much as 25% of its total sales by the end of 1976.

Selected instrument markets. —U.S. firms supply 90% of the *gas chromatographs* purchased in Mexico (see table 3). Sales are expected to rise by 7% annually during the 1974-79 period with the increased use of these instruments. The growing professional skill of technicians is leading many laboratories to replace manual analysis techniques with automated ones for both R&D and quality control applications. *Liquid chromatographs* are not used in Mexico, although several companies are considering future purchases of these instruments.

Sales of *mass spectrometers* are predicted to grow more slowly than the market as a whole because of their high price and limited applications. *Nuclear magnetic resonance spectrometers* are not widely used, although Syntex and Bayer de Mexico have purchased them. Virtually all of the spectrometers sold in Mexico come from American companies.

Low price and numerous, common, uncomplicated applications ensure at least a 10% growth in the market for *pH meters.* They are used by all sectors primarily for quality control. More than 90% come from the United States.

Densitometers are used mainly in electrophoretic analysis in educational, chemical, government, and petroleum laboratories. Consumption of these instruments is expected to increase about 6% annually through 1979. *Thermal analyzers* are not used in Mexico.

German firms supply about 43%, and U.S. manufacturers about 27%, of the *balances* bought in Mexico. Demand should continue to be high for these items, since they are comparatively low priced, have varied applications, and are used in all sectors.

High price is no deterrent to the use of *automatic analyzers,* which are employed mostly for quality control. Sales are expected to climb 10% annually. However, few organizations can afford *electron microscopes*; this market is forecast to grow only 2% annually.

Major Purchasers

Surveys conducted by the Office of International Marketing, Bureau of International Commerce, reveal

Table 2.—Mexico: Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Spectrophotometers			
United States	541	653	433
Germany	11	65	141
United Kingdom	142	41	21
Australia	—	32	—
Others	29	27	21
Total	723	818	616
Gas chromatographs			
United States	323	350	252
United Kingdom	7	4	5
Low countries	—	40	—
Germany	6	13	—
Others	9	3	22
Total	345	410	279
Magnetic fauld detectors			
United States	256	800	1,347
Germany	118	128	94
Switzerland	133	174	71
Spain		—	117
Others	275	383	188
Total	782	1,602	1,700
pH meters, redox meters			
United States	239	436	225
Germany	10	7	20
Switzerland	14	16	—
Canada	17	12	—
Others	7	18	1
Total	287	489	246
Laboratory centrifuges			
United States	227	377	167
Switzerland	4	10	10
Germany	37	74	6
United Kingdom	—	25	5
Others	54	29	9
Total	322	515	197

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[1] January through June.

Source: Direccion General de Estadistica.

that government-sponsored research in Mexico will stress public health, preventive medicine, and environmental control during the next 5 years. The Government, as part of its program to decrease dependence on foreign technology, offers tax advantages to industries that supply 60% of the content, by value, of products manufactured and sold in Mexico. This requires companies to develop local sources of supply, frequently to substitute materials, and, at times, to alter product design. Local industries are therefore increasing their R&D and quality control facilities.

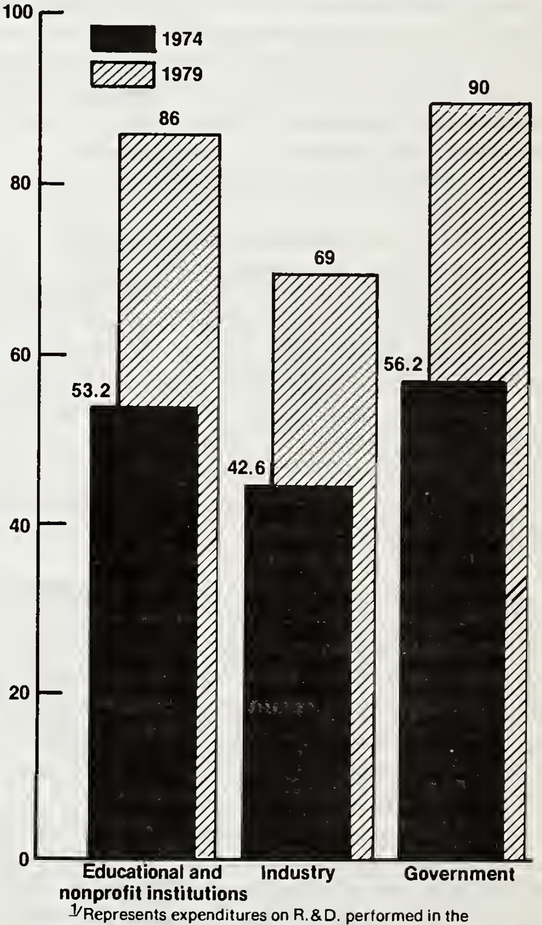
Total R&D expenditures, which amounted to $152 million in 1974, should reach $245 million in 1979, reflecting growth at an average annual rate of 10%. The Government provides about 85% of these funds, retaining nearly 45% of its contribution for its own use and giving 40% to educational and nonprofit research organizations. Even though the Government and education sectors have the largest R&D budgets (see figure 2), industry is the largest consumer of laboratory instruments; the chemical industry alone accounted for 18% of the purchases in 1974 (see table 4).

Mexican laboratories employed 1,140 scientists, 1,680 engineers, and 1,970 technicians, for a total of 4,790 professional personnel in 1974 (see table 5). Nearly all of the researchers working in government and educational laboratories were educated in Mexico. Most industrial laboratory personnel are also locally trained, although some of the U.S. subsidiaries send their research personnel to their American headquarters for various orientation activities and refresher courses.

Government laboratories.—The Government provides 85% of Mexico's R&D funds, but does not control research programs. The only coordinating body, the Consejo Nacional de Ciencia y Tecnologia (CONACYT), subsidizes large educational institutions through scholarships and supports specific R&D programs. CONACYT also coordinates laboratory instrument purchases throughout the Government. Each department within the Government develops its own R&D goals, activities, and physical facilities. Schools and industries that are financed with federal monies function as independent entities. Similarly, the Government does not subsidize or subcontract R&D activities in the private sector.

Altogether, there are 867 laboratories, employing 1,640 trained personnel, run by the various govern-

Figure 2. Mexico: R.&D. expenditures,[1/] 1974 and 1979 (in millions of U.S. dollars)



[1/] Represents expenditures on R.&D. performed in the designated sectors, regardless of the original source of the funds.

Source: Consejo Nacional De Ciencia y Tecnologia and trade source estimates.

ment departments. The Instituto Mexicano de Seguro Social (IMSS), the Mexican Institute of Social Security, is responsible for analytical and related laboratories, and maintains many large hospitals and clinics. The IMSS R&D budget is expected to range from $1.6 million to $2.4 million annually through 1979. The enormous Department of Health includes the Secretaria de Salubridad y Asistencia-Dirrecion de Investigacion en Salud Publica (Bureau of Public Health Research) whose scientific R&D budget ($800,000 in 1974) is expected to increase 32% annually through 1979. This agency is engaged in the development of vaccines, new cultures, antitoxins, and medications; bacteriological, epidermilogical, and immunization process studies; and research in morphology and virus characteristics.

Some of the other government agencies with large R&D budgets include the Secretaria de Agricultura y Ganaderia, Secretaria de Hacienda y Credito Publico, Comision Federal de Electricidad, Instituto Nacional de Nutricion, and the Instituto Nacional de Astrofisica Optica y Electronica.

The specific methods most often used in government laboratories include chromatography, colorimetry, electrography, mass spectrometry, particle size analysis, polarimetry and spectropolarimetry, refractometry, and some X-ray methods. Computer use is neither sophisticated nor well developed, but the increasing complexity of tests and the data generated will probably necessitate interface with instruments such as spectrophotometers, gas chromatographs, and oscilloscopes by 1980.

Instruments which have outstanding sales potential over the next 3 to 5 years are:

- Centrifuges
- Electron microscopes
- Balances
- Thermometers
- Refractometers
- Spectrometers
- Oscilloscopes
- Spectrophotometers
- Photocolorimeters
- Fluorimeters
- Gas chromatographs
- Kjeidahl apparatus
- Analyzers (amino acid pulse height, oxygen, and turbidity)
- pH meters
- Viscosimeters

Educational and nonprofit research laboratories. Over one-third of the nation's R&D funds are spent by the more than 1,000 educational and nonprofit research laboratories. This sector employs nearly half of the country's research personnel, including 70 physicians, 328 chemists, and 117 other life scientists.

The most important educational center in Mexico, Universidad Nacional Autonoma de Mexico (UNAM), is the main source of technical manpower for the business and scientific community. Its areas of specialization include advanced studies in engineering, medicine, chemistry, physics, and biology. UNAM operates a large number of laboratories such as the Centro de Estudios Nucleares, Instituto de Biologia, Instituto de Investigaciones Biomedicas, and the Instituto de Fisica.

Table 3—Mexico: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total sales	U.S. sales	Total sales	U.S. sales
Gas chromatographs	559	503	780	700
Mass spectrometers	108	106	140	140
Spectrometers	247	247	320	320
pH meters	493	449	790	720
Densitometers	97	96	130	130
Balances	1,071	289	1,730	470
Automatic analyzers (orsat)	14	13	20	21
Electron microscopes	448	134	500	150

Source: Values based on Mexican trade source estimates.

UNAM is involved in a substantial expansion program. The University plans to add 49 laboratories in 1975 at a total cost of $11.2 million; another 38 in 1976 for $11.7 million; 24 in 1977 for $10.6 million; at least 7 in 1978 costing $6.4 million; and 4 in 1979 for another $6.4 million. Four new laboratories will also be added to the medical school, starting in 1976, at a cost of $1.2 million.

The second largest center, Instituto Politecnico Nacional (POLI) operates approximately 40 laboratories The institute is gaining in importance, as is shown by its 47% annual budget increases over the past 4 years; the R&D budget more than tripled between 1972 and 1974, from $4.4 million to $13.8 million. POLI includes the Centro de Investigacion y Estudios Avanzados, Escuela Nacional de Ciencias Biologicas, Escuela Superior de Medicina, Escuela Superior de Ingenieria Mecanica y Electrica, and the Escuela Superior de Ingenieria Quimica e Industrias.

This sector utilizes all types of analyses, particularly chromatography, colorimetry, electron microscopy, mass spectrometry, and refractometry. No laboratory computers are now in use, and only UNAM mentioned possible future interface with gas chromatographs, mass spectrometers, and spectrophotometers. Demand will be high over the next 5 years for the following:

- Analyzers
- Balances
- Colorimeters
- Centrifuges
- Gas chromatographs
- Densitometers
- Mass spectrometers
- Microscopes
- Polarimeters
- Refractometers
- Spectrophotometers
- Thermometers
- Spectrometers
- Potentiometers
- pH meters

Laboratories in the chemical industry.—Overall sales for Mexico's chemical industry reached nearly $2.5

Table 4.—Mexico: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	867	4,582	7,380	3,288	4,880
Educational and nonprofit institutions	1,044	6,449	11,170	4,914	7,7220
Independent commercial laboratories	162	199	350	169	300
Medical organizations	229	771	1,240	627	930
Industry:					
Oil and gas extraction	53	2,395	7,600	1,559	3,490
Food products	40	752	1,400	407	600
Chemicals	663	4,642	7,300	3,073	4,430
Petroleum	39	1,983	6,060	1,288	2,590
Rubber and plastic products	39	723	1,050	525	680
Stone, clay, and glass	38	121	150	102	110
Primary metals	27	811	1,510	542	930
Fabricated metal products	25	248	350	186	220
Transportation equipment	20	194	310	135	220
Other	37	195	310	130	190
Total	3,283	24,065	46,170	16,945	27,290

Source: Values based on Mexican trade sources estimates.

billion in 1973, when investment totaled $136 million. Both investment and sales are expected to increase by 10% annually between 1974 and 1979, accompanied by faster growth in some sectors, especially pharmaceuticals. Laboratory expenditures should rise at a similar rate, with instrument purchases increasing from $3.1 million in 1974 to $4.4 million in 1979. Some of the major products of the industry include sulfuric, nitric, and phosphoric acids; soda ash; fertilizers; ammonium sulfate and nitrate; polyurethane; polyethylene; and thermoplastic resins.

The chemical industry employs about 330 professional workers including 130 chemists and 90 engineers in its 663 laboratories. Almost 85% of these laboratories are in the pharmaceutical sector; the 60 or 70 largest accounting for 45% of laboratory instrument purchases. Since most of the pharmaceutical companies are foreign owned, the Mexican branches are more concerned with quality control than with R&D the latter generally being done in the home office. However, the development of new products for introduction into the Latin American market is among the most important planned activities of these subsidiaries. Specific projects include the development of steroid and nonsteroid chemical substances for use in bronchial dilation, birth control, cardiovascular activities, and central nervous system operations; and the development of a synthetic hormone base and new applications for synthetic hormone products.

The chemical industry forecasts annual expenditures of $560 million for new plants through 1978. Industrias Resistol Plastics Division is planning a 33.3% increase in its laboratory investments by 1977 or 1978. The Chemical Division of Industrias Resistol is contemplating a $14-million investment in plants to double its chemical output capacity by 1979. Quimica Fluor and Quimica Mexicana started building a $64-million hydrofluoric acid plant in Matamoros at the end of 1974. Industrias Resistol and Celanese Mexicana are investing $10 million in a phenol plant; this project is scheduled for completion by 1977. Penwalt de Pacifico, S.A. has announced plans for a $14 million caustic soda plant with an annual capacity of 50,000 metric tons near Guadalajara. Petrocel, S.A. has undertaken construction of a dimethyl terephthalate and terephthalic acid plant at a cost of $64 million. Guanomex recently announced a $96-million, long-range investment program to increase capacity in ammonium sulfate and urea, while American Hospital Supply plans to invest $2.4 million in a plant to produce plasmas and reagents at Cuernavaca. In addition, the Benavides industrial group intends to build a $2.4-million plant at Ramos Arizpe.

The specific laboratory methods most commonly used in the chemical industry are chromatography, colorimetry, electric paramagnetic resonance, polarimetry, spectropolarimetry, saccharimetry, refractometry, and some X-ray methods. Some companies are exploring computer interface with gas chromatographs, spectrometers, balances for standard engineering, potentiometers, and spectrophotometers. However, no company in this sector had computer interface in 1975. One pharmaceutical manufacturer has an IBM System 3 and is assessing the practicality of using the hardware. Most consumers would prefer minicomputers to complete systems because of the cost factor.

The following instruments are most likely to be in demand over the next 3 to 5 years in the chemical industry.

Analyzers
Balances
Gas chromatographs

Table 5.—Mexico: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
	Physics	Chemistry	Other life		
Employed by:					
Government	50	230	80	590	690
Industry	20	200	40	250	300
Educational and nonprofit institutions	70	330	120	840	980

Source: Consejo Nacional De Ciencia y Tecnologia and trade source estimates.

Mass spectrometers
pH meters
Polarimeters
Centrifuges
Fluorimeters
Densitometers
Refractometers
Penetrometers
Tensiometers
Colorimeters
Thermometers
Psyclorometers
Pyrometers
Infrared detectors
Viscosimeters
Spectrophotometers
Microscopes

Laboratories in the petroleum industry.—The Mexican petroleum industry is entirely government owned. The national company, Petroleos Mexicanos (Pemex), had 1973 sales of $157 million in petrochemicals and $1.5 billion in petroleum, natural gas, and related products. In petrochemicals, this amount represented an 18% increase in domestic sales over those for 1972 and a 12.4% increase in exports; petroleum and natural gas sales were 14.9% higher. Growth of at least 10% annually is forecast from 1974 to 1979, resulting in 1979 sales of nearly $3 billion. Laboratory expenditures are expected to increase an average 25% annually between 1974 and 1979, while instrument purchases increase an average 15%, reaching nearly $2.6 million in 1979.

Pemex has three main divisions engaged in R&D activities. The Petrochemical Division is concerned with all aspects of petrochemical production. This division employs 54 engineers and 140 technicians; its R&D budget is expected to grow from $40 million in 1974 to $64 million in 1979. Purchases of instruments for this division are expected to increase from 1% to 2% of R&D expenditures, starting in 1976 when construction begins on 18 petrochemical plants in two industrial complexes, "La Congerjera" and Cadereyta, Nuevo Leon. These two complexes will cost an estimated $384 million during the 1976-78 period.

The Refining Division processes crude oil and natural gas and accounts for approximately 20% to 22% of the laboratory instruments purchased by Pemex. The Instituto Nacional del Petroleo (IMP) is the research arm of Pemex. During 1972-1973, it was responsible for research in such areas as the development of a process to reduce sulfur in combustibles and the hydrosulfurization of gasoline. IMP's R&D expenditures reached $1.6 million in 1974 and are expected in 1979 to reach $2.6 million, including $510,000 for laboratory instruments. This division alone employs more than 300 technical personnel, of which 37% are engineers, 6% chemists, 4% physicists, and the remainder technicians.

Pemex is modernizing its existing refinery facilities and building several new ones. A new refinery at Tula, started in 1974 and scheduled for completion in 1976, will cost $292 million. Expansion of the Pacifico plant, began in mid-1975 and is expected to cost $14 million over the 2-year construction period. Expansion of the refineries at Salina Cruz, Minatitlan, and Monterrey, at a cost of $17.2 million, was completed in 1975. Laboratory equipment will probably amount to less than 1% of investment, since the primary objective of these projects is to increase plant output capacity.

Some methods used in the petroleum industry are chromatography, colorimetry, particle size analysis, spectrophotometry, and some X-ray methods. Pemex is contemplating using computers with such instruments as gas chromatographs, spectrometers, and spectrophotometers; this planning is in the early stages, however, and no computer/instrument interface presently exists. Instruments expected to be in demand over the next few years include:

Gas chromatographs
Spectrophotometers
pH meters
Viscometers
Alkalimeters
Air sampling and analysis equipment
Colorimeters
Hydrometers
Voltmeters
Centrifuges
Balances
Microscopes
Absorptionmeters
Monometers
Carbon analyzers
Nitrogen analyzers
Oxygen analyzers
Particle size analyzers

Trade and Technical Regulations

Tariff rates on laboratory instruments range from 2% to 35%, with most items assessed at 10% of value. Mexico is a member of the Latin American Free Trade Association and the Andean Pact and gives preferential duty rates on some items to other members of these associations. Further information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

Electrical power is supplied throughout Mexico by the government-operated power commission. The

Federal District (Mexico City) and nearby Cuernavaca, Toluca, and Pachuca operate on 50 hertz, 125 volts alternating current. The rest of the country is supplied with 60 hertz, 110 volts current. A program is underway to convert to 60-cycle power in the central area by 1980. All electrical equipment sold in Mexico must be able to operate on both 50 and 60 cycles.

Mexico uses the metric system of weights and measures. Accordingly, documents accompanying equipment should be in metric units, although there are no restrictions on importation of equipment calibrated in the English system.

No specific technical standards covering laboratory instruments exist, but import permits must be obtained from the Department of Foreign Commerce, Office of Import Permits, Secretary of Industry and Commerce. Permits, designed primarily to protect local industry, are not issued for products also manufactured in Mexico.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Mexico is available on a continuing basis from:

Country Marketing Manager-Mexico
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

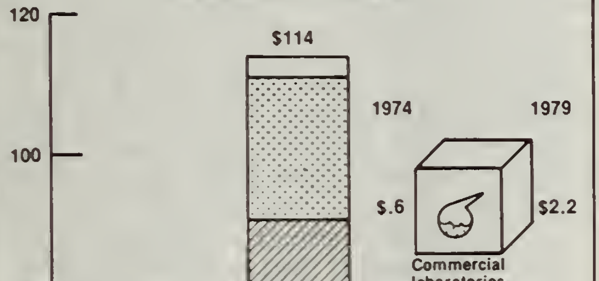
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Mexico," DIB 75-12-506, May 1975.

Netherlands

The Netherlands provides a dynamic market for laboratory instruments. Sales increases averaged a spectacular 36% annually from 1972 through 1974, as the market expanded from $35.8 million[1] to $66.1 million (see table 1). Sales in 1975 are estimated at $78.1 million. Continued growth is forecast for the remainder of the decade, with sales of $114 million projected for 1979, reflecting a vigorous growth rate of approximately 12% a year in the 1974-79 period.

Figure 1. Netherlands: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report; values based on Dutch trade source estimates.

Due to the high national priority given to research in the physical and life sciences in the Netherlands, laboratory expenditures totaled $525 million in 1974, accounting for almost half of total R&D spending. The continued interest in laboratory research and the expansion of the industrial base support the forecasts of a thriving market for laboratory instrumentation The industrial sector represents a major market since 1979 expenditures for R&D laboratories are anticipated to reach $460 million, and laboratory instrument purchases are projected at $68 million, approximately 60% of the total instrument market (see figure 1).

Continued major expenditures for laboratories in the chemical, primary metals, fabricated metals, and food processing industries should provide the major stimulus for instrumentation sales within the industrial sector. Moreover, the Netherlands has become one of Europe's principal centers for industrial research. Several multinational corporations have located their central research laboratories there, contributing significantly to the industrial R&D base and providing exceptional markets for advanced and highly specialized laboratory instruments. New sales opportunities for laboratory instruments used in space research are also expected during the remainder of the 1970's as construction of a laboratory for the European Space Program gets underway.

Major laboratory investments are budgeted by the Government for research programs in medicine, energy, environmental conservation, and nuclear technology. Also important will be purchases of laboratory instruments for research in agriculture,

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = Hfl. 3.21 (1972); Hfl. 2.81 (1973 and subsequent years).

Table 1.–Netherlands: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	32.7	57.5	68.0
Imports	24.9	33.4	39.1
Exports	21.8	24.8	29.0
Market size[1]	35.8	66.1	78.1

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[1] Market size equals production plus imports minus exports.
Source: Values based on Dutch trade source estimates.

fishery, hydrology, and oceanography. These fields are of particular interest because of the nation's size and geographic circumstances. Sales of instruments to government laboratories are expected to increase 11% annually from 1974 through 1979 and to reach $23 million in 1979; over this same period a 12% annual increase is expected in sales to medical, educational, and nonprofit research laboratories, bringing the total for these institutions to $20.8 million in 1979.

Competitive Environment

A high degree of competition characterizes the Dutch market for laboratory instruments as most of the world's major manufacturers participate in this market (see table 2). Imports play a vital role, providing about 50% of the total market; they are projected to reach over $57 million in 1979, more than double the $24.9 million recorded during 1972.

Trade sources estimate that over half of the laboratory instruments sold in the Dutch market are manufactured by American companies located in the United States or Western Europe (Germany, the United Kingdom, Switzerland, and Ireland, in addition to the Netherlands). U.S. suppliers provide approximately 25% of total imports through shipments of laboratory instruments from the United States; these imports rose from $7.4 million in 1972 to $9.1 million in 1974 and are expected to exceed $14 million in 1979. The market share held by U.S. imports, as high as 21% in 1972, has been estimated at 14% in subsequent years and is expected to remain at this level through 1979. A portion of this decline represents competition from European subsidiaries of American firms; however, there have also been increases in sales by domestic manufacturers and other foreign suppliers. The newest and most sophisticated products of American design generally are supplied by U.S.-based companies, whereas the more conventional instruments and those widely used in European laboratories usually are purchased from subsidiaries located within the European Economic Community (EEC), primarily in Germany.

U.S. manufacturers have been most successful in selling advanced instruments, particularly those characterized by high degrees of accuracy, operational convenience, modular design, and the feasibility of interfacing with minicomputers. Components are also purchased by Dutch instrument manufacturers; and estimated 25% of U.S. laboratory instrument imports are components used in the assembly of Dutch instruments or as spare parts for European distribution.

The principal manufacturers supplying the Netherlands with instruments produced in the United States are Beckman Instruments, Digital Equipment, Tektronix, Varian, Perkin-Elmer, Hewlett-Packard, du Pont de Nemours, Technicon, Finnigan, Nuclear-Chicago, Orter, Bausch & Lomb, and Tracor. Many of these firms also supply the Dutch market from their European subsidiaries.

Laboratory instruments are manufactured by about 50 firms in the Netherlands; total production was valued at $57.5 million in 1974 and is forecast to reach $100 million by 1979. Exports represented $24.8 million in 1974 and are expected to reach $42.8 million in 1979. The industry consists of a few large firms with extensive R&D activities, and export-oriented production, and around 40 small and medium-size firms will serve the domestic market and are largely assembly operations. With the exception of one large American subsidiary, the major manufacturers are Dutch owned.

Domestic suppliers provide the majority of pH meters and oscilloscopes sold in the Netherlands and expect to strengthen their sales position for most other types of instruments by 1979 (see table 3). Exports, however, are the industry's main objective; marketing efforts are expected to be concentrated on developing sales in other European countries. Potential for expanding sales by small Dutch firms lies in furnishing instruments especially designed or adapted to the specific needs of the purchaser. There are no government programs to encourage domestic production of laboratory instruments, and Dutch suppliers enjoy no special advantages over foreign competitors other than the cost and service factors normally associated with market proximity.

Philips BV, is the largest domestic manufacturer of laboratory instruments; sales of such items totaled $15 million to $20 million in 1973 and accounted for 1% to 2% of Philips' business. Philips produces spectrophotometers, electron microscopes, chromatographs, automatic analyzers, nuclear radiation instruments, electrochemical instruments, X-ray instruments, and electric and electronic measuring instruments.

Other major manufacturers are Enraf Nonius, whose laboratory instrument sales of $3 million in 1973 represented about a third of the firm's marketing efforts. Production includes chromatographs, air quality measuring instruments, X-ray diffractometers, and X-ray recorders. Kipp & Zonen devotes 60% to 70% of its business (sales of about $3 million in 1973) to the production of such laboratory instruments as photometers, densitometers, and recorders. Vitraton and Vitraton Medical, manufacturers of photometers, densitometers, electrophoresis equipment, and laboratory recorders, and Dr. C.E. Bleeker NV, which produces refractometers, goniometers, galvanometers, and parts and accessories for optical instruments, are also significant suppliers of the local market. Vitraton sales of laboratory instruments approximated $1 million in 1973 and instrumentation sales by Bleeker totaled $2 million for the same year.

The largest of the four U.S. subsidiaries located in the Netherlands is Packard Becker, which recorded laboratory instrument sales of $3 million to $5 million in 1973, representing about 80% of its business; production includes gas chromatographs, amino acid analyzers, gamma spectrometers, and radio-chromatographic scanners. Other subsidiaries have less extensive operations in the Netherlands, Baird Atomic Europe BV produces nuclear instrumentation, including NIM electronic spectrometers and densitometers, and had sales of $1.0 million to $1.5 million in 1973. Cenco Instrumenten's sales reached about $1 million in 1973; they produce polarimeters, colorimeters, and analyzers for clinical chemistry. Du Pont de Nemours BV has reportedly begun production of liquid chromatographs in the Netherlands.

Germany is Holland's primary source of imported laboratory instruments. German producers of conventional optical and mechanical instruments are particularly well established in this market, but they encounter greater competition for sales of electronic and electrical instruments. The principal German suppliers to the Dutch market include Carl Zeiss, Ernst Leitz, Heraeus, Heraeus-Christ, Siemans, Frieseks & Hoepfner, and Bruner Physik. Also significant are the subsidiaries of U.S. manufacturers located in Germany which, according to trade sources, provide an estimated 40% to 50% of the laboratory instruments imported by the Netherlands from Germany. These subsidiaries include Beckman Instruments, Bodenseewerk, Perkin-Elmer, Varian-MAT, and Hewlett-Packard.

English suppliers have been particularly successful in selling electrical and electronic instruments in the Netherlands; they follow German and U.S. sources in total import sales. The principal U.K. suppliers are AEI Scientific Apparatus, Rank Precision, Joyce Leobl, Pye Unicam (a subsidiary of Philips), Locar, and Cambridge Instruments. French suppliers provide less than 10% of imports; they include Cameca, Intertechnique, Tacoussel, and Schlumberger. Imports from Japan consist mainly of conventional and electron microscopes, and Swiss manufacturers sell mechanical and electronic precision balances, ultracentrifuges, and X-ray spectrometers.

Selected instrument markets. — According to research conducted for the Office of International Marketing, Bureau of International Commerce, ***gas chromatographs*** are widely used in the Netherlands; sales of these instruments are expected to reach $5 million in 1979, twice the 1974 level. Most of this increase will represent purchases by industrial and institutional laboratories in the petrochemical, food processing, and pharmaceutical industries. Dutch purchasers generally expect to obtain the following features with their gas chromatographs: modular design of electronic and penumatic systems, wide selection of columns, computer-compatible electronics, easily replaceable columns, and replaceable detectors and detector combinations.

Table 2.-Netherlands: Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Laboratory centrifuges			
United States	204	323	334
Germany	368	544	283
United Kingdom	258	188	46
France	8	—	—
Other	11	114	65
Total	849	1,169	728
Electron and proton microscopes, electron diffractometers			
United States	20	13	—
Germany	53	29	27
Japan	469	—	—
Switzerland	61	179	—
Other	35	14	243
Total	638	235	270
Optical microscopes			
United States	20	34	—
Germany	637	859	465
Japan	469	581	295
Switzerland	61	48	—
Other	187	1,153	219
Total	1,374	2,675	979
Equipment for analyzing gases			
United States	72	63	42
Germany	382	542	268
United Kingdom	44	41	75
France	23	12	—
Other	153	22	28
Total	674	680	413

January-June.

Source: Central Bureau voor de Statistiek.

Flame ionization is the most prevalent form of detection utilized, but dual detector/ dual column combinations, thermal conductivity, thermoionic, and electron capture detectors are also used. Application of digital data handling systems is growing, and there is a rapidly expanding market for gas chromatograph-mass spectrometer combinations. A high degree of competition characterizes this market with some 15 foreign and 3 domestic manufacturers contending for sales. Imports (chiefly U.S. instruments from Perkin-Elmer, Hewlett-Packard, and Varian) currently supply 70% of this market, but domestic sales are expected to reach 35% by 1979. Although the technical quality of U.S. instruments is well established, imports of gas chromatographs from the United States are expected to decline gradually as American subsidiaries increase production of these instruments in Germany and the Netherlands and as other European suppliers provide stronger competition.

Although ***liquid chromatographs*** have been used for years in the Netherlands, new applications will boost sales by an estimated 23% a year from 1974 through

Table 3.–Netherlands: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974				1979			
	Total	United States	Other foreign	Domestic	Total	United States	Other foreign	Domestic
Gas chromatographs	2,500	500	1,250	750	5,000	750	2,500	1,750
Liquid chromatographs	700	280	350	70	2,000	900	700	400
Mass spectrometers	2,000	600	1,200	200	4,500	1,800	1,800	900
NMR spectrometers	1,700	850	850	—	3,000	1,500	1,500	—
pH meters	1,000	50	350	600	1,600	80	560	960
Densitometers	1,400	280	560	560	1,800	270	720	810
Thermal analyzers	500	200	300	—	1,000	300	500	200
Oscilloscopes	2,000	300	400	1,300	3,400	680	680	2,040
Optical spectrometers and spectrographs including photometers	11,000	3,850	4,950	2,200	20,500	7,180	8,200	5,120
Nuclear radiation measuring instruments	1,500	600	600	300	2,300	920	690	690

Source: Values based on Dutch trade source estimates.

1979, providing a market of $2 million in 1979. Most purchases will be made by children's clinics and industrial laboratories concerned with food processing (including breweries and dairies), fodder production, agricultural chemistry, pharmaceuticals, and biochemistry. Imports comprise 90% of liquid chromatograph sales, and U.S. manufacturers (mainly Beckman, Perkin-Elmer, du Pont de Nemours, and Varian) are well established suppliers. German firms (Bender & Hobein, Dr. H. Knauer, and Serva) provide most of the competition. All high performance liquid chromatographs are imported; U.S. manufacturers, as the initial suppliers of these instruments, enjoy a special advantage in this field. Detectors in use include single ultraviolet (UV) wavelength, scanning spectrophotometers, and refractometers. All chromatographic processes, including liquid-solid absorption, liquid partition, ion-exchange, gel filtration, and gel permeation are required for research purposes. Gradient elution is performed in most laboratories, and there is considerable demand for liquid chromatographs which allow alteration of the gradient program. Fraction collection devices are a feature frequently required by research institutes. Demand is growing for computing integrators and data systems for use in liquid chromatography.

Sales of *mass spectrometers* are expected to increase by almost 18% annually from 1974 through 1979, reaching $4.5 million in 1979. Mass spectrometers are used primarily for structure analysis of organics and hydrocarbons, pharmaceuticals, biological research, pesticide studies, pollution analysis, nuclear sciences, surface analysis of semiconductor materials, and stable isotope analysis. More than half the mass spectrometers in current use are sector field instruments. However, trade sources expect demand to shift toward quadrupole and dodecapole instruments, with quadrupole types gaining appreciably as their resolving power and cost attract more purchasers. For sector field mass spectrometers, the trend is toward increased use of double-beam instruments. Almost half the mass spectrometer purchases are gas chromatograph-mass spectrometer combinations, mostly quadrupole; sales of these units are expected to increase more rapidly than the general mass spectrometer market. Accompanying the growing mass spectrometer sales will be increased demand for data aquisition and real-time mass determination systems.

Imports provided 90% of the mass spectrometers sold in the Netherlands in 1974; local production is confined to the ion probe mass spectrometer manufactured by Philips. U.S. firms lead in spectrometer sales and are expected to improve their market share substantially in the 1975-79 period. Varian and AEI are the leading suppliers of sector field instruments; their chief competitors are LKB-Produkter (Sweden) and Thomson-Houston (France). Finnigan is the leading supplier of quadrupole instruments, with competition from suppliers in France and Liechtenstein.

Imports supply the total market for *nuclear magnetic resonance (NMR) spectrometers;* U.S. suppliers lead in sales and are expected to maintain their strong position. More than half the sales of these instruments are made by Varian and Perkin-Elmer. Other major suppliers are from Germany (Bruker Spectrospin) and Japan (JEOL Europe). Sales are expected to increase approximately 12% a year from 1974 through 1979, reaching $3 million in 1979. Trade sources expect demand to focus on analytical spectrometers, mainly 90-megahertz NMR spectrometers with thermostatically controlled permanent magnet systems. Scarce research funds will limit sales of the more expensive high-resolution, multinucleus NMR spectrometers.

Modest growth is forecast for sales of *pH/minivolt (mV) meters* through the end of the 1970's, with total sales projected at $1.6 million in 1979. Laboratories involved in water analysis, biochemistry, food processing, fodder production, and agricultural chemistry will be the chief purchasers. Greater sales potential is expected for ion-sensitive electrodes, which are widely used in potentiometric titrations, and in hydrochemistry (including sewage analysis), food processing, galvanics, and medicine. Though over 30 manufacturers compete for sales, domestic producers hold about 60% of the market. Competition among foreign suppliers is vigorous, with German, Danish, and French firms participating. The U.S. market share of about 5% is expected to be maintained as U.S. manufacturers provide specialized components and ion-selective electrodes.

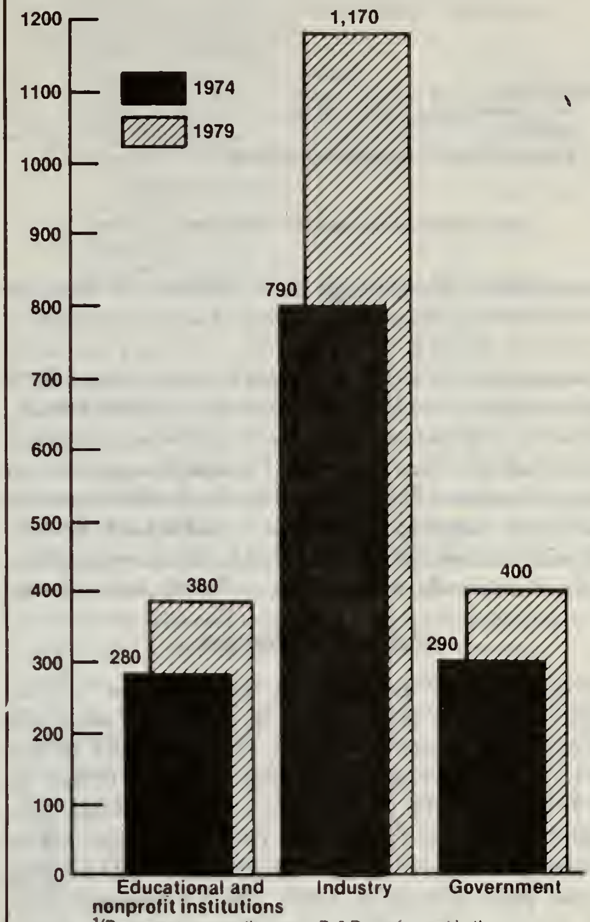
Sales of *densitometers* are expected to reach $1.8 million in 1979. During the 1975-79 period, most purchases will be made by research laboratories seeking high-quality instruments with monochromators. Densitometers with automatic scanning and integrated recording will be in great demand, and a decline is expected for sales of instruments operated with filters or nonwavelength-variable monochromators. Domestic manufacturers supply about 40% of the market and are expected to increase their share to 45% by 1979. The chief import suppliers are Beckman and Carl Zeiss. U.S. manufacturers supply most of the optical parts and high-quality monochromators used in Dutch densitometers, but they face increasing European competition in this field.

The market for *thermal analyzers* is projected at $1 million in 1979, double the 1974 sales level. Demand for these instruments is expected to increase as they are used in materials testing and evaluation and in chemical research, where differential thermal analyzers (DTA) will be purchased for research involving catalyst and reaction cybernetics. Universally applicable units with DTA and thermal gravimetric analysis (TGA) capabilities are preferred by most purchasers, as are changeable ovens for low and high temperatures. Laboratories which study the thermal decomposition products of solids have also displayed increased interest in thermal analyzers combined with mass spectrometers. Perkin-Elmer, du Pont de Nemours, and Fisher Scientific are leading suppliers, but they face strong competition from Swiss (Mettler Instruments) and German (Netsch and Linseis) firms. Additional competition will be provided by domestic production, which is expected to supply 20% of this market by 1979.

Oscilliscope sales are expected to increase approximately 11% a year from 1974 through 1979, when they are projected at $3.4 million. Digital processing, sampling, and storage oscilloscopes will be in demand; plug-in amplifiers, time bases, and curve tracers are also expected to sell well. Among the 12 manufacturers offering these instruments, Philips is a clear leader with 60% to 65% of sales. U.S. suppliers include Tektronix and Hewlett-Packard; their chief third-country competitors are Solatron Electronic (United Kingdom) and Schlumberger (France). The U.S. stronghold in this market has been high frequency (up to 14 gigahertz) instruments. Trade sources anticipate growing demand for these instruments, and the U.S. market share is expected to increase.

Sales of *optical spectrometers and spectrographs, spectrophotometers, and photometers* totaled $11.0 million in 1974 and are expected to reach $20.5 million by 1979; varied rates of growth are anticipated for the different instruments within this market. Strong growth is forecast for sales of spectrophotometers ($5 million in 1974) with exceptional demand expected for the atomic absorption, fluorescence, and single-beam instruments used in basic and environmental research. Substantial growth is also forecast for sales of optical spectrometers and spectrographs to metals industry laboratories. Less dramatic expansion is expected in the photometer market (sales totaled $4.5 million in 1974) where the demand for major purchasers is hospitals and industrial laboratories (largely those for food and beverage processing) has already been met. Some 40 manufacturers sell these instruments in the Netherlands. U.S. suppliers are among the leaders in sales of sophisticated instruments, particularly atomic absorption and fluorescence spectrophotometers. Major competitors of U.S. firms include Carl Zeiss, Pye Unicam, Philips, Kipp and Zonen, and Vitraton.

Figure 2. Netherlands: R.&D. expenditures, [1/] 1974 and 1979
(in millions of U.S. dollars)



[1/] Represents expenditures on R.&D. performed in the designated sectors, regardless of the original source of the funds
Source: Centraal Bureau voor de Statistiek.

Most laboratories that use *nuclear radiation measuring instruments* are well equipped, and moderate sales growth of approximately 9% annually is

Table 4.—Netherlands: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
	Physics	Chemistry	Other life		
Employed by:					
Government	570	390	70	2,070	18,700
Industry	630	540	630	2,800	27,500
Educational and non-profit institutions	530	530	260	1,980	6,100

Source: Centraal Bureau voor de Statistiek.

forecast from 1974 through 1979. Demand will focus on scintillation counters, semiconductor detectors, neutron detectors, sample changes, and chromatographic scanners. Imports supply about 80% of this market, and U.S. manufacturers (Baird Atomic, Packard Instruments, and Nuclear-Chicago) furnish about half of these imports. Foreign competition is mainly German (Frieseke & Hoepfner) with domestic production supplied by Philips and Packard Becket. U.S. sales in this field are boosted by the incorporation of American-made components in Dutch instruments.

Major Purchasers

Research and development expenditures in the Netherlands have risen sharply in the last 15 years and are expected to increase about 7.5% annually in the 1974-79 period, reaching a total of $1.95 billion in 1979. Industry, the leading source of R&D funds, supplied $730 million for R&D in 1974 and is expected to provide $1.1 billion in 1979. Government R&D funding totaled $630 million in 1979. The Government contributes about $60 million annually to industrial R&D, primarily to support development of nuclear energy and space technology and provides from $200 million to $400 million for R&D needs of educational and other nonprofit organizations.

R&D activities are concentrated in medical, industrial product development, and agricultural fields, but also of considerable and growing importance are pollution control, energy diversification, and environmental conservation. An estimated 60% to 70% of total R&D spending ultimately becomes laboratory expenditures in the Netherlands.

Industrial R&D expenditures are forecast at $1.17 billion in 1979 (see figure 2). Chemicals, primary metals, food and beverages, and electronics traditionally lead in industrial R&D activities, but space technology will also become prominent as the result of VFW Fokker's contract for the European Space Program. Industry supported 125 R&D laboratories in 1974 and purchased laboratory instruments valued at about $40 million; industrial demand is expected to increase by more than 11% annually from 1974 through 1979, bringing the level of laboratory instrument purchases to $68 million in 1979.

Government R&D expenditures are projected at $400 million in 1979, while educational and nonprofit institutions are expected to use $380 million. Laboratory instruments will constitute an important component of increased R&D spending in Government-supported sectors; purchases of instruments for the 570 laboratories are expected to increase from $25.4 million in 1974 to $43.8 million in 1979.

The high standards of its technical colleges and university programs have assured the Netherlands of an adequate supply of scientific and technical personnel; in 1974 there were 11,000 scientists and engineers and over 52,000 technicians employed in the physical and life sciences (see table 4). An estimated 2% to 3% of the nation's scientists recieved graduate training in the United States; most of its scientific and technical personnel read English and are familiar with American scientific journals. Fluency in German is also common in the scientific community, and German scientific publications are widely read.

Government laboratories. —R&D activities are conducted by 290 institutes of the Netherlands Government, which employs 3,100 scientists and engineers and 18,700 technicians. Most institutes are interuniversity organizations or are associated with the Netherlands Organization for the Advancement of Pure Research (ZWO), Royal Netherlands Academy of Sciences and Letters, Ministry of Education and Science, or the Netherlands Central Organization for Applied Scientific Research (Nederlandse Centrale Organisatie voor Toegepast-Natuurwetenschappelikj OnderzoekTNO).

High priority is given to environmental conservation in government laboratories; energy research follows in importance and considerable attention is directed to agriculture, oceanography, hydrology, and basic research in biophysics, biochemistry, and solid-state physics. An estimated 190 R&D laboratories are associated with the government institutes (see table 5). Laboratory expenditures at each of the 10 largest institutes are above $3.5 million a year, and at another 30 to 40 institutes they range from $1.0 million to $3.5 million. Small budgets, generally less than $1 million, are typical of the other institutes. Government laboratories purchased instruments valued at $13.6 million in 1974, expansion of research activities and laboratory facilities is expected to boost purchases to $23 million in 1979.

Institutes associated with the TNO are among the major purchasers of laboratory instruments, and the following research programs at TNO laboratories will create additional demand for instruments.

- Corrosion studies of metals and alloys in pure and salt water
- Corrosion of nuclear fuel cladding material
- Sintering methods
- Plasticity and alloy softening of iron-nickel alloys
- Recrystallization studies
- Determination of isotope composition of fission products
- Analytical research of activation analysis
- Physical and chemical properties of airborne particles enclosed in contaminants of different geometries

Enlargement of TNO research facilities in Delft and expansion of most other TNO laboratories will also provide exceptional opportunities for sales of laboratory instruments.

The analytical methods used in government laboratories include chromatography, electrometric methods, electron microscopy, mass spectrometry, particle size analysis, radiometry, spectrometry, and X-ray. Computerized instruments are used increasingly for control and evaluation of nuclear research, spectrophysics, and data storage in holographic research.

The R&D activities of Government laboratories are expected to stimulate demand for the following instruments.

- Signal averagers (boxcar integrators)
- Computer-controlled X-ray diffractometers
- Electrochemical oxygen and polarographic analyzers
- Gas chromatographs
- Gas chromatograph-mass spectrometer combinations
- Liquid chromatographs
- Solid state detectors
- Scanning electron microscopes
- Infrared (IR)-Fourier, Auger low energy electron diffraction, Lasar Raman, and NMR spectrometers
- Phase integrators
- Atomic absorption, UV-visible, and stopped flow spectrophotometers
- Ion-sensitive electrodes
- Oscilloscopes and digital processing oscilloscopes
- Spectroradiometers
- Universal digital meters
- Data acquisition systems for gas and liquid chromatographs, mass spectrometers, and amino acid analyzers

Educational and nonprofit research laboratories. Activities of the 100 laboratories in this sector comprise a broad spectrum of research in natural sciences and technology. Medical research in universities receives strong emphasis, with nutrition, cancer, and gerontology the primary fields. Also of notable importance are organic and inorganic chemistry, theoretical and applied physics, biology, and other life sciences. Some 3,300 scientists and engineers and 6,100 technicians are employed in the R&D activities of this sector.

Most large laboratories are connected with the science, medical, or technical facilities of the principal universities and high schools; large clinical complexes are also attached to these institutions. Some 10 to 15 laboratories are considered large-scale, with their annual expenditures exceeding $3.5 million; budgets in another 30 laboratories range from $1.0 million to $3.5 million.

Table 5.—Netherlands: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories[1]	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	190	110	160	13.6	23.0
Educational and nonprofit institutions	100	95	145	11.8	20.8
Independent commercial laboratories	15	5	15	.6	2.2
Medical organizations[2]	280	—	—	—	—
Industry:					
Oil and gas extraction	5	5	10	.6	1.2
Food products	30	20	25	2.5	3.7
Chemicals	45	95	140	12.1	20.7
Petroleum	5	15	20	1.9	3.0
Rubber and plastic products	2	3	3	.2	.4
Stone, clay, and glass	1	2	2	.3	.3
Primary metals	5	70	100	8.9	14.8
Fabricated metal products	5	60	90	6.7	10.2
Transportation equipment	4	10	20	.6	1.2
Other	23	35	50	6.2	12.5
Total	710	525	780	66.0	114.0

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[1] All laboratories included in nonmedical categories are dedicated to R&D activities.

[2] Laboratory expenditures and instrument purchases for medical organizations are included in educational and nonprofit category.

Source: Values based on Dutch trade source estimates.

Several laboratory construction projects and major research programs will boost laboratory instrument purchases in this sector during 1974-1979. Medical facilities in Maastricht will be expanded, and large clinics will be established at Amsterdam University and at Leiden and Utrecht. Substantial expansion is also planned for the Technical High School in Delft. The following research programs will require additional purchases of laboratory instruments:

- Immunochemical research
- Blood factor determination
- Experimental genetics
- Macromolecular fundamental research
- Plasma-physical research
- Mossbauer scattering
- Solid-state physics
- Analysis of nuclear fields irradiated under experimental conditions by neodymium methods

Analytical methods in current use include chromatography, colorimetry, electrometric techniques, electron microscopy, electrophoresis, mass spectrometry, radiometry, and spectrometry. Online computers are used increasingly in these laboratories, particularly for research on blood circulation and heart catheterization; they are also used in cryophysics, physics of thin layers, and the interaction of X-rays and electronics.

The following laboratory instruments are expected to constitute sales opportunities in this sector during the remainder of the 1970's:

- Multichannel analyzers
- Amino acid analyzers
- Automatic integrating densitometers
- Gas chromatographs
- Scanning electron microscopes
- Phase integrators
- Data acquisition systems for gas chromatographs and mass spectrometers

Laboratories in the chemical industry.—Sustained growth and development are forecast for the Dutch chemical industry, and this expansion will be accompanied by continued emphasis on R&D activities within the industry. The chemical industry's R&D laboratories rank among the largest consumers of laboratory instruments in the Netherlands; annual purchases are expected to exceed $20 million by 1979. Dutch firms and multinational chemical companies maintain a total of 45 R&D laboratories, 10 of which have annual expenditures of more than $3.5 million. The other 35 laboratories operate on annual budgets that range between $1 million and $3 million. Average expenditures in another 100 to 120 laboratories within the chemical industry are less than $1 million a year. Chemical industry laboratories employed 1,700 scientists and 2,800 technicians in 1974.

The industry's research activities are directed primarily toward the development of new plastics and improved synthetic fibers; pharmaceuticals (psychopharmacology, antidiabetes drugs, and veterinary vaccines); extraction of protein from mineral oil and natural gas; agrochemicals, fertilizers, and pesticides; use of natural gas to replace mineral oil as a raw material for the chemical industry; and development of environmentally acceptable processing technologies. Analytical methods in general use include chromatography, electron paramagnetic resonance, mass spectrometry, NMR, and refractometry.

Sales of minicomputers for these laboratories are growing rapidly; instruments currently interfaced with minicomputers include gas and liquid chromatographs, amino acid analyzers, and spectrometers.

Expansion of existing facilities and construction of new laboratories will augment sales opportunities for laboratory instruments during the 1975-79 period. The Akzo Research Laboratories will expand the Boxmeer facilities of its subsidiary Organon to accommodate research on anti-inflamation drugs, antifertility drugs, and diagnostic drugs; Akzo will also expand its laboratories in Groningen. Shell will close its Rijswijk laboratory and concentrate laboratory facilities in Amsterdam, where substantial investments are planned. Esso will include new laboratories in its $100-million plant in Terneuzen, and DSM Ned. Staatsmijnen's new factory in Groningen will include new laboratories.

Several research programs within the chemical industry will provide additional sales opportunities for laboratory instruments. The major programs will involve: electrochemistry of molten salts and complex formation in concentrated solutions; thermodynamic stability of stationary states in continuous reactive systems; development of measuring methods for ion-newtonian liquids; nitrogen components in natural oils biodegradation of hydrocarbons and mineral oils; and mechanism and cybernetics of the disproportion of olefins.

During the remainder of the 1970's the chemical industry's demand for laboratory instruments is expected to focus on the following:

- Gas chromatographs
- Gas chromatograph-mass spectrometer combinations Liquid chromatographs
- Energy-dispersive X-ray, IR-Fourier, Laser Raman, NMR, multichannel, and X-ray spectrometers
- Amino acid, electrochemical oxygen, polarographic, multichannel, and sequential automatic analyzers
- DTA
- TGA
- Atomic absorption and UV-visible spectrophotometers
- Fluorometers
- Ion-sensitive electrodes
- Activation analysis equipment
- Analytical balances
- Data acquisition systems for gas and liquid chromatographs
- Mass spectrometers
- Amino acid analyzers.

Laboratories in the primary metals industry.—The vigorous growth displayed by the primary metals industry during the past decade is expected to continue through the 1970's, with industry sales levels reaching $2.2 billion to $2.4 billion by 1979. Although the Netherlands does not possess natural ore resources and lacks coke and coal for processing, the primary metals industry has made profitable use of imported ores and has been in the forefront of efforts to develop and apply new processing technologies. Capital expenditures for the industry were $310 million during 1973 and are expected to approach $500 million by 1979. R&D activities have been instrumental in supporting the growth of this industry, and laboratory expenditures are expected to continue their upward trend, reaching $100 million in 1979.

The R&D laboratories of five manufacturers account for 80% to 90% of the industry's purchases of laboratory instruments; annual expenditures in these laboratories exceed $3.5 million. Another 40 to 50 laboratories are maintained by firms in the primary metals industry for materials testing and evaluation. Total employment in the industry's laboratories is estimated at 800 scientists and 2,000 technicians.

The research efforts of the principal iron and steel manufacturer, Hoogovens (Estel), are directed towards production of valuable alloys and pollution control; the latter field has become a sideline as Hoogovens now sells its pollution control systems under licensing arrangements. New product development at Hoogovens is concentrated on special steels, primarily alloys for construction in the chemical and transportation industries and corrosion-resistant steels for bridge construction and shipbuilding.

Four firms making nonferrous metals lead in R&D activities: Aldel, Billiton, Pechine, and Lips. Their research efforts have been directed toward extraction of such rare metals as indium, antimony, arsenic, cadmium, selenium, tellurium, thallium, bismuth, and super-refined (99% pure) phosphorus.

The analytical methods used in primary metals laboratories include magnetic susceptibility, electrometric, spectrometric, thermal, and X-ray methods. Laboratory computers are in demand; X-ray diffractometers are generally interfaced with minicomputers while NMR instruments are partly interfaced and partly integrated into closed electronic data processing systems.

Expansion of the large R&D laboratories and the research projects planned by this industry will offer significant sales opportunities for laboratory instruments during the late 1970's; the principal research projects involve the metallurgy of high purity metals, behavior of ferroelectrons near the Curie point, and cryological research.

The following instruments are expected to be in considerable demand:

Energy dispersive X-ray and multichannel X-ray spectrometers
Computer-controlled X-ray diffractometers
Phase integrators
Ion-sensitive electrodes
DTA and TGA
Dilatometers
Activation analysis equipment.

Trade and Technical Regulations

Tariff rates for laboratory instruments imported from countries outside the EEC range between 5% and 13%. Tariffs for new EEC members (United Kingdom, Ireland, and Denmark) and the former members of the European Free Trade Association (Sweden, Austria, Switzerland, Norway, Portugal, and Finland) are being reduced gradually and will be eliminated in 1977; they were subject to a 60% reduction in 1975. Laboratory instruments, not produced in the Netherlands, that are imported for R&D purposes are exempt from customs duties. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The characteristics of the Netherlands' electrical power supply are 220 volt, 50 hertz, 2- and 3-phase. The metric system of weights and measures is the statutory standard.

Technical standards applicable to laboratory instruments are established by the Normalisatie-Instituut, Polakweg 5, Rijswijk, Netherlands. Information on the availability of published standards for laboratory instruments in the Netherlands may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Netherlands is available on a continuing basis from:

Country Marketing Manager-Netherlands
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

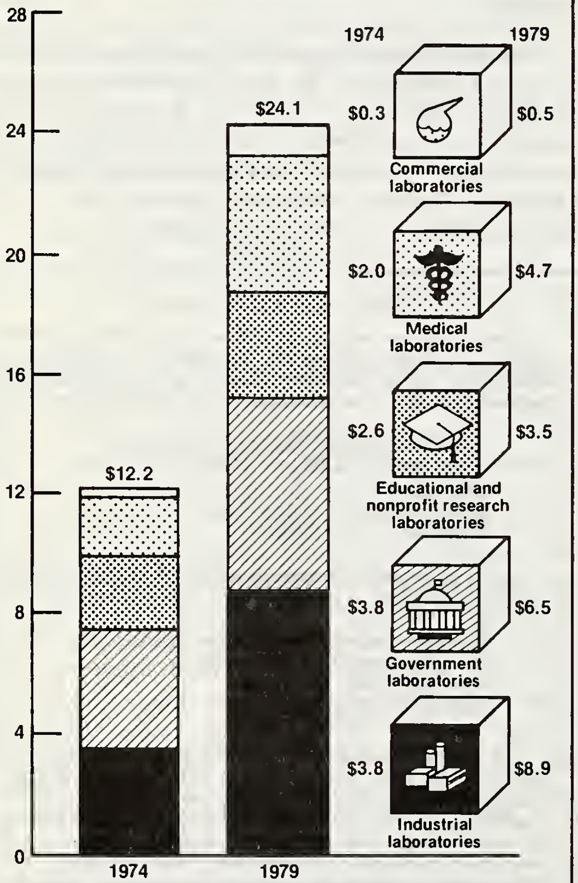
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Netherlands," DIB 75-07-510, March 1975.

Republic of China (Taiwan)

Prospects are favorable for sales of laboratory instruments to the Republic of China (Taiwan). The market, almost entirely dependent upon imports is expanding vigorously and increasing in sophistication. Research requirements that stem from the country's rapid pace of industrial development are mounting with large new investments in petroleum, petrochemicals, and metals production offering particularly strong laboratory instrument market potential. There is continuing heavy demand in basic and defense-oriented research, and many of the small consumer products industries are stepping up their quality control operations.

Figure 1. **Republic of China (Taiwan): The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)**



Source: Bureau of International Commerce, Office of International Marketing research report; values based on R.O.C. trade source estimates.

Forecasts place total laboratory instrument sales in 1979 at over $24 million[1], nearly double the 1974 level (see figure 1). Based on the 1972 value of $8.7 million, the market grew at an average annual rate of 20% through 1974. An additional 10% rise is estimated for 1975 bringing the market to nearly $14 million (see table 1).

Total laboratory expenditures are likely to double between 1974 and 1979, rising from $24 million in the earlier year to $48 million in the latter. Almost all end-user groups are expected to increase their laboratory instrument purchases as demands for laboratory services rise and pressures to upgrade equipment intensify. An additional stimulus is the growing number of scientists and technicians being trained and employed.

Due to a strong emphasis on product development, industrial laboratories will probably experience the fastest growth and displace government laboratories as the principal consumers of laboratory instruments in the country between 1974 and 1979. In the latter year, industrial laboratories' aggregate expenditures are expected to amount to $18 million, including $9 million for instruments. Medical laboratories are also developing rapidly; their 1979 expenditures are projected at $9.1 million and their instrument purchases at $4.7 million (see figure 1).

Competitive Environment

Taiwan's continuing dependence on foreign suppliers for both conventional and advanced equipment should

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = NT $40 (1972); NT $38 (1973 and subsequent years).

Table 1.—Republic of China (Taiwan): Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	.05	.09	.1
Imports	8.68	12.49	13.7
Exports	.03	.04	—
Market size[1]	8.70	12.54	13.8

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[1] Market size equals production plus imports minus exports.

Source: Values based on Chinese trade source estimates.

bring total import purchases of laboratory instruments to $24 million in 1979, in contrast to $12.5 million in 1974. An increasing diversity in the supply pattern is emerging as the strong growth potential and a progressive shift to automatic and technically advanced instruments attract intensified competition among international manufacturers. Although Japanese firms will probably remain the leading source of supply, U.S. and European manufacturers are expanding their influence in the market (see table 2).

Improvements in research standards, product development, and quality control are expected to afford U.S. laboratory instrument manufacturers a good market for specialized and technologically refined instruments. Imports from the United States are anticipated to rise from $4.37 million in 1974 to $5.5 million in 1975, increasing the U.S. share of imports from 35% to 40%. U.S. imports in 1979 are estimated at $9.1 million or 38% of the import market. However, trade sources attribute the slight decline in market share to a probable weakening of the official policy that has favored the United States as a source of supply and additional European competition.

A preference for U.S. products has developed in the Republic of China as American instruments are generally considered to be of higher technical quality and more durable than those of competing suppliers. The selection of U.S.-made equipment is also influenced by the large amount of direct U.S. investment in the country, and the fact that most of Taiwan's scientists who are trained abroad receive their education in the United States. Also significant are the many "tied-aid" programs and advisory agreements resulting from traditionally close ties between the two countries.

U.S. manufacturers are heavily represented in sales of gas chromatographs (Varian; Hewlett-Packard Co.); atomic absorption spectrophotometers (Varian; Bausch & Lomb Optical); other spectrophotometers (Coleman Instruments; Perkin-Elmer Instrument Co.; Beckman Instruments); liquid scintillation spectrometers (Packard Instruments); other spectrometers (Beckman; Fisher Scientific Co.); colorimeters (Coleman); automatic analyzers (Coleman; Scientific Instruments); oscilloscopes (Tektronix); laboratory centrifuges (International Equipment Company); and textile testing equipment (Spinlab Company). A wide range of additional equipment is sold from the United States, and a large number of other manufacturers also compete successfully in the market. In addition to direct sales from the United States, many American companies offer equipment produced by foreign subsidiaries and licensees, especially those in Japan, the United Kingdom, and Australia.

While support services are not considered deficient, trade sources believe that U.S. manufacturers could improve their market position if additional consideration were given to timely delivery of spare parts, maintenance of good service facilities, and programs for training local personnel in the operation and repair of equipment.

The leading third-country suppliers in the market are Japan, whose import share declined from 47% in 1972 to 44% in 1973; and Germany, whose share expanded from 6% to 8% during the same time frame. Japanese firms such as Hitachi, Shimadzu Seizakusho, Yanagimoto, and the Japan Electro Optics Laboratory (JEOL) compete directly with U.S. suppliers for sales of many equipment items; in some cases, due to licensing agreements or technical arrangements with American firms, offering equivalent instrumentation. The Japanese have a particularly strong position with respect to sales of scintillation counters, nuclear magnetic resonance (NMR) spectrometers, electron and other types of microscopes, X-ray apparatus, and centrifuges. Total 1973 imports from Japan amounted to $4 million in value.

In the same year, imports from Germany amounted to almost $730,000. Manufacturers, including Carl Zeiss, Eppendorf, Ernst Leitz, and Siemens, primarily furnished balances, micromanipulators, and microscopes. Other countries with significant sales volumes are Switzerland (balances and distillation apparatus), the United Kingdom, and Australia.

Domestic competition is limited to one firm, Janco Electronics Ltd., which assembles digital pH meters under license from Photovolt of the United States. Janco, which began operations in 1974, is expected to furnish about 40% of the country's pH meter requirements in 1979. The firm anticipates eventually expanding output to 1,000 sets annually for export as well as for domestic production. A certain amount of "in-house" production also takes place, but consists primarily of simple instruments such as voltmeters.

Including "in-house" production, total domestic manufacture is forecast at $180,000 in 1979, approximately double the 1974 total. No further development of manufacturing capacity is expected, and the achievement of an appreciable export volume is unlikely; shipments from Taiwan will probably continue to consist largely of reexports.

Selected instrument markets.—A research study recently conducted in the Republic of China (Taiwan) for the Office of International Marketing, Bureau of International Commerce, included an analysis of the market for 11 selected laboratory instruments (see table 3). A discussion of some of the major factors affecting sales follows.

Gas chromatograph purchases are shifting in favor of automated equipment, such as the recently introduced Hewlett-Packard Model 5830A reporting chromatograph with a digital processor. The high unit cost of this equipment should bring total sales to slightly over $1 million in 1979. U.S. manufacturers should retain a 65% share of the market as new instruments are acquired by technologically sophisticated laboratories in the petroleum and synthetic fibers industry. The principal competition is from Japanese manufacturers, but U.S. suppliers are considered to have technological superiority and provide better service.

Liquid chromatographs are anticipated to gain wider use in pharmaceutical, medical, agricultural, and plastics laboratories. Total purchases are projected to increase from about $30,000 in 1974 to about $400,000 in 1979. Considered highly advanced, and too expensive for general use, these instruments are relatively new to the market; only about 10 units, supplied principally by Varian and JEOL, have been installed. The introduction of these machines in more and more laboratories is expected to afford U.S. manufacturers the opportunity to expand their share of the market from about 50% (or $15,000) in 1974 to about 80% or ($320,000) in 1979.

Prospects for sales of *mass spectrometers* are poor due to their high cost, and because other equipment can usually be used to obtain similar results. At present fewer than 10 units are installed, and future sales in excess of 1 or 2 units annually appear unlikely. With the market limited to the largest and most technically sophisticated laboratories in the country, trade sources project a stable sales level of $180,000 annually between 1974 and 1979. American suppliers should retain an 80% market share because of the good reputation of their spectrometers.

With remaining demand focused on small *NMR spectrometers* suitable for teaching purposes, rather than on computer-interfaced models, total sales probably will not exceed $100,000 annually in 1979. As is the case with other types of advanced spectrometers, U.S. firms should be able to maintain a good market position because of technological innovations and good reputation. Competition from Japanese suppliers, however, is expected to be strong.

Sales of *pH meters* number between 200 and 300 sets annually, placing them among the most widely used laboratory instruments in the Republic of China. Recently begun domestic production is expected to erode the import market, though U.S. manufacturers should remain preeminent among the foreign suppliers due to the reliability and durability of their sets. Important third-country competitors are Radiometer (Denmark), and Toa Electronics Ltd., Toyo, and Hitachi Horiba (Japan).

The market for *densitometers* is adversely affected by their high cost and limited applicability; trade sources expect imports of only about 5 units annually. The reliability and comparatively reasonable cost of U.S. instruments should assure them of at least 50% of total sales. The principal U.S. manufacturers represented are Photovolt and Gilford Instruments; their major competitor is Toyo.

Table 2.—Republic of China (Taiwan): Imports of selected laboratory instruments, 1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Machines and appliances for testing hardness, strength, elasticity, etc., of materials			
United States	235	211	99
Japan	542	376	208
Germany	42	90	33
Switzerland	7	57	16
Other	102	44	28
Total	928	778	384
Instruments for physical or chemical analysis (except exposure meters and gas detectors)[2]			
United States	566	406	1,044
Japan	391	191	272
Germany	42	57	78
Hong Kong	7	30	18
Other	323	97	194
Total	1,329	781	1,606
Electrical or electronic instruments for measuring nonelectrical properties			
United States	1,409	1,436	
Japan	1,511	1,734	
Germany	214	267	
United Kingdom	104	166	
Other	185	354	
Total	3,423	3,957	3,594

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[1] January through September.

[2] Country breakdown not available.

Source: Values based on Republic of China trade source analysis of import data compiled by the Statistical Department, Inspectorate General of Customs, Republic of China.

Thermal analyzers are also little-used in the Republic of China, although sales opportunities should develop at some petrochemical and medical laboratories. A market value of $100,000 is predicted for 1979, compared with $90,000 in 1974. The principal suppliers have been du Pont (United States) and Shimadzu.

Among chemical and hospital laboratories there is a rapidly expanding demand for *automatic analyzers* that is expected to boost total purchases of these instruments to $1.3 million in 1979, probably making them the largest single category of laboratory instruments. At present U.S. equipment, manufactured by Technicon, dominates the market; Pye Unicam (United Kingdom) and Yanagimoto (Japan) are also represented. As the market grows, imports from Japan are expected to become more important, but strong U.S. leadership should prevail.

Taiwan laboratories purchase between five and eight *electron microscopes* annually. These instruments are either solid-state reflectant microscopes for solid-state physics laboratories or the transmission type for medical laboratories. Demand is increasing, and as import purchases rise from about $360,000 in 1974 to $550,000 in 1979, U.S. manufacturers should be able to gain greater access to the market. At present, most electron microscopes are purchased from Hitachi or JEOL while a few are bought from Siemens.

Torsion balances are the type most frequently purchased in Taiwan, although use of more sophisticated instruments, such as electrobalances, is becoming more widespread. The trend toward advanced instrumentation is expected to increase total balance sales from about $380,000 to $550,000 between 1974 and 1979. The principal suppliers are Mettler (Switzerland) and Sartorius (Germany), both of whom have a reputation for good quality and durability, as well as excellent service support. U.S. manufacturers, represented chiefly by Cahn Division, Ventron Instruments, have been able to obtain a 10% share of the market.

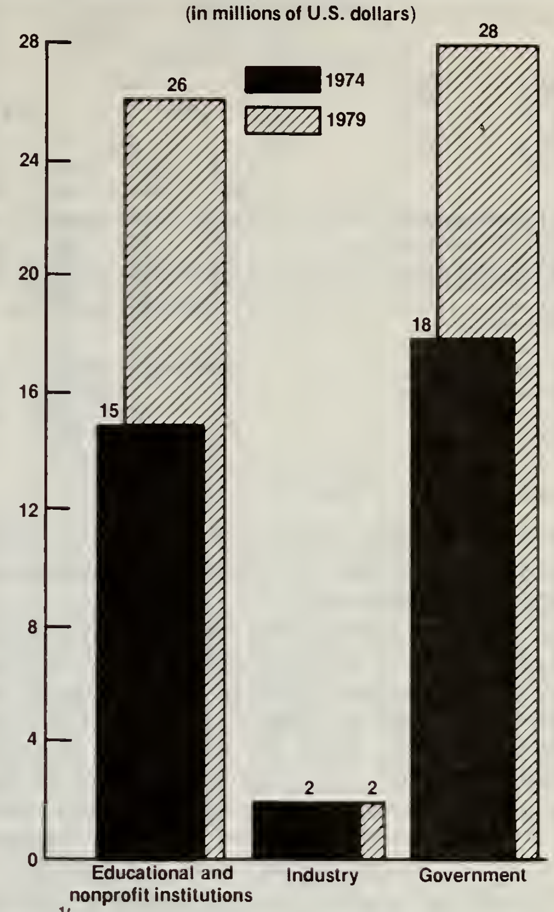
Major Purchasers

Applied science and industrial research are receiving a high priority as the nation strives to improve agricultural efficiency, become more self-sufficient in energy production, broaden its industrial base, and generally upgrade products. Specific areas of inquiry (in addition to agriculture) likely to require intensified laboratory activity are chemicals, petrochemicals, plastics, synthetic textiles, electronics, steel, shipbuilding, nuclear energy, petroleum, and oceanography.

Total R&D funds are projected to increase from $35 million in 1974 to $56 million in 1979 (see figure 2). The R&D emphasis will shift from social science and educational research to engineering and the physical and life sciences. The government should continue to supply about 80% of total R&D funds over this period, and universities to contribute about 14%; however, their expenditures, due to government support are nearly equal. Some large public sector research institutes are located at universities, and there is close cooperation between staffs. At such facilities, a large proportion of R&D allocations are spent on equipment and direct project costs, because regular government and university budgets absorb most salaries and other recurring expenses. Industry has only recently begun large-scale R&D, and its total funds and expenditures are relatively low.

The total number of scientists, engineers, and technicians was approximately 28,000 in 1974 (see table 4); the ranks of scientists are increasing rapidly, with colleges and universities turning out an estimated 2,100 science graduates annually. Many graduates go abroad for advanced studies: an estimated 80% go to the United States and most of the remainder to Japan. Also, under a special program, over 200 young faculty members and research scientists receive training at foreign universities, chiefly in the United States. American scientists of Chinese extraction are frequently recruited for positions in Taiwan. A cooperative science program, sponsored by the Republic of China National Science Council and U.S. National Science Foundation, provides for an exchange of scientists, joint seminars, and research in areas of mutual interest.

Figure 2. Republic of China (Taiwan): R&D expenditures, [1] 1974 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the original source of the funds.

Source: Values based on R.O.C. trade source estimates.

Government laboratories.—Seeking to develop a strong scientific capability for both strategic and economic reasons, the government established a cabinet-level agency, the National Science Council, to formulate policy and allocate public funds. It also founded a national academy of science, the Academia Sinica, to provide leadership in research.

The government operates about 20 laboratories that engage in a range of basic and applied research in support of various industrial and military programs. Trade sources estimate that in 1974 the government laboratories employed approximately 600 scientists, 4,000 engineers, and 5,000 technicians. In the same year, government facilities spent a total of $7 million, of which $3.8 million was used for instrument

Table 3.—Republic of China (Taiwan): Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total sales	U.S. sales	Total sales	U.S. sales
Gas chromatographs	630	410	1,040	680
Liquid chromatographs	30	15	400	320
Mass spectrometers	180	140	180	140
NMR spectrometers	70	35	100	50
pH meters	100	50	150	50
Densitometers	30	15	30	20
Thermal analyzers	90	72	100	80
Automatic analyzers	300	285	1,300	1,170
Electron microscopes	360	—	550	60
X-ray analyzers	90	54	150	110
Balances	380	38	550	60

Source: Values based on Chinese trade source estimates.

purchases (see table 5). In 1979, expenditures should rise to $12.9 million and include $6.5 million for purchase of instruments.

The foremost government scientific research centers are the Academia Sinica Institutes of Physics, Chemistry, Botany, and Biological Chemistry, and the Industrial Technology Research Institute (ITRI). Additional facilities, under the jurisdiction of various ministries, specialize in research and testing in communications, transportation, standards, agriculture, forestry, fisheries, livestock, food and drugs, veterinary medicine, environmental sanitation, and textiles.

The Institute of Physics conducts basic research in nuclear, solid-state, and low-temperature physics and atmospheric science. Recent projects include a nuclear spectroscopic study from proton capture reaction; an investigation of the energy levels of nuclei from thermal-neutron capture using coincidence spectrometers; a simulation of typhoon and atmospheric phenomena; and inquiry into the hydrodynamics of ship design. Also underway are studies of magnetic transition in thin conducting films, the properties of thin magnetic films, other magnetic effects, and electron spin resonance measurement.

The Institute of Chemistry is concerned with the chemical factors affecting the growth of nonsulfur bacteria in the seawater around Taiwan; the isolation and characterization of proteins from bacterial cells and of cellulose-decomposing enzymes from fungi; in addition to NMR spectroscopy of organic chemicals. Some of the major equipment items in use are a gas chromatograph and spectrophotometer (Hitachi), scintillation counter (Ortec), and infrared (IR) diffraction gratings spectrometer (Perkin-Elmer).

The Institute of Botany performs research in cytogenetics, plant breeding, plant physiology, plant nematology, tissue culture, biochemistry, plant ecology, microbiology, and biometry. Principal equipment currently in use includes an electron microscope with ultraminicrotomic capabilities, a micromanipulator, ultracentrifuges, automatic amino acid analyzers, a gas chromatograph, spectrophotometers, and a liquid scintillation spectrometer.

The Institute of Biological Chemistry has begun studies of biologically active proteins. Its area of special interest is snake venom protein.

The ITRI, with nearly 500 scientists and technicians, carries out applied research related to minerals, metals production, mining technology, energy resources, metallurgy, and mechanical engineering. It also investigates production methods used in the electronics, plastics, chemicals and most other industrial sectors. Some of the major instruments employed in ITRI laboratories are a gas chromatograph, micromanipulator, thermal conductivity analyzer, carbon/hydrogen/nitrogen analyzer, IR and X-ray spectrophotometers, and NMR and direct reading optical emission spectrometers. Recent purchases have included a large proportion of electronic instruments.

The scope and volume of government research activities indicate good sales opportunities for a wide spectrum of laboratory instruments. Expansion in the level of research activity should provide especially good prospects for instruments for petroleum, nuclear, and metals research.

Educational and nonprofit research laboratories.—Projections indicate that the 40 laboratories in this category will increase total expenditures from $4.8 million in 1974 to $7 million in 1979 and that instrument purchases will rise from about $2.6 million to $3.5 million during the period. At present, new equipment purchases are inhibited by a curtailment in government funding, but trade sources believe that the situation will ameliorate as worldwide inflationary pressures and economic uncertainty lessen.

The universities perform research in many fields and employ almost 13,000 scientific personnel, including 400 physicists, 600 chemists, and 1,200 researchers in the other life sciences. Areas of special interest are nuclear energy, chemistry, and metals.

Among the analytic techniques applied extensively are gas chromatography, fluorescence methods, polarimetry, pH methods, atomic absorption flame photometry, and microscopy. Computers are frequently used for the analysis of data in electronics and other laboratories. Although the National Taiwan University has recently purchased a Hewlett-Packard HP2100 minicomputer, and the Chung Cheng Institute of Technology has a Hitachi Model 505 analog computer, such machines have not yet been directly interfaced with other laboratory instruments.

Probable equipment replacements and the growing demand for instruments to speed up research and facilitate handling large volumes of data are expected to create favorable sales potential for the following items:

Table 4.—Republic of China (Taiwan): Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
	Physics	Chemistry	Other life		
Employed by:					
Government	50	150	400	4,000	5,000
Industry	5	50	90	2,000	3,500
Educational and nonprofit institutions	400	600	1,200	4,000	6,500

Source: Manpower Development Committee, Council for International Economic Cooperation and Development, Republic of China, and trade source estimates.

Automatic analyzers
Gas chromatographs
Spectrometers
Digital pH meters
Spectrophotometers
Oscilloscopes

Laboratories in the petroleum industry.–The state-owned Chinese Petroleum Corporation (CPC), which operates all phases of petroleum and gas exploration, extraction, refining, and distribution in the country, plans massive investment, probably exceeding $200 million annually, over the next few years. Major objectives are the expansion of refining capacity from 220,000 to 320,000 barrels daily, and the development of a large naptha complex that will furnish new downstream petrochemical production capacity. Exploration activity also will increase.

Petroleum laboratory expenditures should increase from $1.9 million in 1974 to $4.2 million in 1979, and instrument purchases, from $900,000 to $2.4 million in that period. Most of the expenditure will be directed toward applied research, testing, and product development; as is the case with other industrial laboratories, little basic research is conducted. Some of the principal fields of inquiry are stratigraphic investigations; drilling, refining, and petrochemical technology; and pollution control. Of great potential significance is product development research in petroleum fermentation, aimed at improving microorganism strains and the recovery of vitamins and organic acids from fermentation mash to produce n-paraffin feedstocks. A pilot plant has been put into operation to furnish sufficient feedstocks for feasibility testing.

CPC has a total of 10 laboratories located at plant sites; most are small, specialized facilities. The firm's 3 large research centers, at Ja Yi, Kaohsiung, and Daling, account for about 80% of the sector's laboratory expenditures and employ most of its 150 laboratory personnel. Approximately one-third of CPC's workers are chemists or biochemists; the remainder are engineers and technicians.

In general, the level of technology in CPC laboratories is high. The company possesses a total of 16 gas chromatographs, some of which have minicomputer modules for the conversion of analog data into digital form. Colorimetry, polarimetry, spectropolarimetry, mass spectrometry, NMR spectrometry, and other spectrometric methods are frequently used. Also, laboratory data is often processed electronically.

Laboratory instruments expected to be in demand by the petroleum industry include:

Gas chromatographs
pH meters
Balances
Oxygen analyzers
Automatic analyzers
Synthetic textile testing instruments, including tensile and yarn testers

Laboratories in the chemical industry.—Exceptionally rapid growth is forecast for chemical laboratories as new petrochemical industries operating downstream from the CPC naptha complex begin production. The fertilizer industry is also expanding, and quality control is being upgraded on an industrywide basis. The chemical industry's total laboratory expenditures, the largest aggregate amounts of any industrial sector, are likely to exceed $7 million in 1979, with about $3.3 million for instrument purchases.

Petrochemical development is expected to draw a total of $200 million in new investment. New facilities, presently operating or scheduled to open shortly, will produce caprolactam, polyacrylonitrile, and polyester fiber. Large artificial rubber, polyethylene, and polypropylene plants are now in planning or in the initial stages of construction. Additionally, five new fertilizer plants will add 750,000 metric tons (MT) annually to the country's 1974 capacity of 900,000 MT. The new plants, which will be fully operational in 1976, will produce ammonium sulfate fertilizer (based on caprolactam byproducts), compound fertilizer, urea, and liquid ammonia.

Most of the 80 laboratories in the sector are small facilities engaged primarily in quality control and product development. Medium-size laboratories are operated by some of the larger companies engaged in chemicals production, such as the Taiwan Fertilizer Company (1975 production was about 1.07 million MT); the Taiwan Alkali Company (49,300 MT of hydrochloric acid, 71,000 MT of caustic soda, and 18,000 MT of titanium dioxide), and the Chung Tai Chemical Industries Corporation (8,300 tons of caprolactam).

Frequently used techniques include photometry, spectrophotometry, gas chromatography, and pH methods. Few laboratories process data electronically,

Table 5.—Republic of China (Taiwan): Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	20	7.0	12.9	3.8	6.5
Educational and nonprofit institutions	40	4.8	7.0	2.6	3.5
Independent commercial laboratories	200	.5	1.0	.3	.5
Medical organizations	50	4.3	9.1	2.0	4.7
Industry:					
Oil and gas extraction	1	.1	.5	—	.2
Food products	25	.2	.5	.1	.2
Chemicals	80	2.5	7.2	1.3	3.3
Petroleum	10	1.9	4.2	.9	2.4
Rubber and plastic products	10	.5	1.4	.3	.7
Stone, clay, and glass	15	.5	.5	.3	.7
Primary metals	4	.5	1.0	.3	.5
Fabricated metal products	3	.4	.6	.2	.3
Transportation	5	.1	.2	—	.1
Other	30	.7	1.9	.4	1.0
Total	493	24.0	48.0	12.5	24.1

Source: Values based on Chinese trade source estimates.

and no computer-interfaced equipment has yet been purchased.

The following instruments appear to have favorable potential for sales to chemical laboratories:

Flame photometers
Ultraviolet-visible spectrometers
Automatic analyzers
Gas chromatographs
pH meters

Other laboratories.—There is a significant level of laboratory activity in many other industries, primarily for quality control and product development. Equipment needs range from relatively simple instruments used for testing food toxicity to advanced spectrometers and spectrophotometers used in testing metals. A major project with strong potential for laboratory equipment sales is a new steel mill under construction by the China Steel Corporation. This facility will have a capacity of 1.5 million MT of iron and steel products per year.

Trade and Technical Regulations

Most imports of laboratory instruments are assessed customs duties of 19%, but the rate ranges up to 46% for some items. Government, nonprofit, and university laboratories may import instruments free of duty.

Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The electrical supply is 110 volts, 60 hertz, single-phase, and 220 volts, 60 hertz, 3-phase. For weights and measures, the metric system is used.

Information concerning standards applicable in the Republic of China may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York, 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Taiwan is available on a continuing basis from:

Country Marketing Manager-Taiwan
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

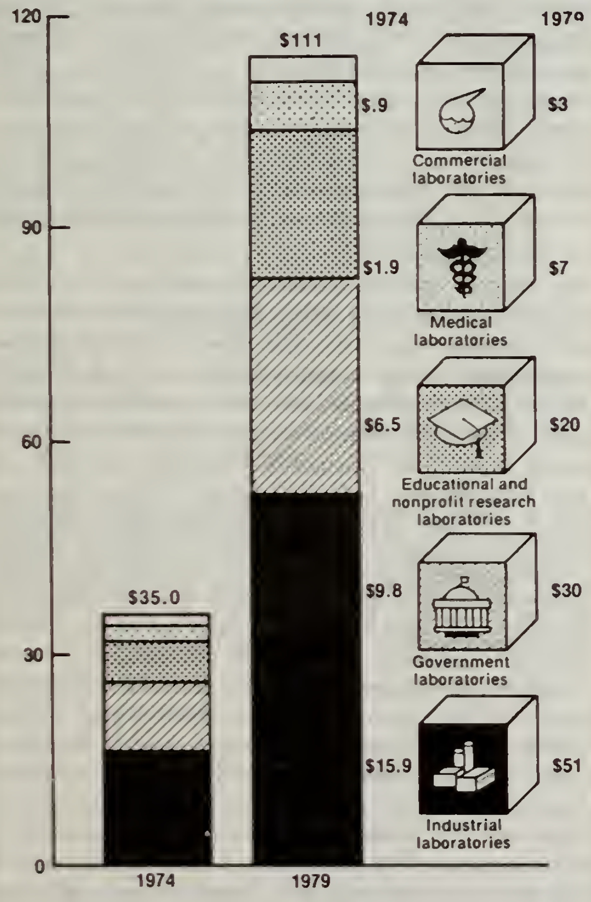
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—Taiwan," DIB 75-08-509, February 1975.

Spain

In their determination to reduce the dependence on imported technology built up during Spain's period of rapid industrialization, government planners are pouring millions of dollars into research and development (R&D) programs designed to benefit specific industries. Since these efforts can only be fully successful if additional research facilities are constructed, equipped, and suitably staffed, laboratory expenditures will rise sharply during the next few years. Accordingly, the Spanish market for laboratory instruments is forecast at $111 million[1] for 1979, more than triple 1974's level of $35 million and reflecting an average growth of 26% annually. Purchases rose by more than 30% per year between 1972 and 1974 (see table 1). Spending for laboratory instruments in 1975 is estimated at $44 million.

Figure 1. Spain: The market for laboratory instruments, 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce Office of International Marketing research report values based on Spanish trade source estimates

Laboratories maintained by the Spanish Government are expected to have expenditures of $244 million in 1979, two and one-half times their 1974 outlays of almost $98 million. Such facilities may increase their laboratory instrument purchases by threefold from $900,000 in 1974 to $30 million in 1979 (see figure 1). Current government research emphasizes the use of nuclear energy made from domestic uranium reserves to produce electrical power as well as for oceanographic studies of Spain's coastal waters.

In addition to projects undertaken in their own interest, Spain's educational and nonprofit research laboratories perform valuable studies under contract to both private industry associations and government agencies. The growing volume of industry-commissioned research and the specific tasks likely to be assigned under the Fourth Development Plan (1976-1979) should help to boost laboratory expenditures from $43 million in 1974 to $107 million in 1979, or by about 20% per year. Educational and nonprofit laboratories may more than triple their purchases of instruments, spending $20 million for such purposes in 1979 compared with $6.5 million in 1974.

Spanish industry is finding that the demands of the export market and, in the case of food processors, more stringent government standards can only be met by equipping and staffing company laboratories to do bet-

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = Ptas 64.50 (1972); 58.80 (1973); 57.00 (1974 and subsequent years).

Table 1.—Spain: Size of market for laboratory instruments, 1972, 1974, and 1953

(in millions of U.S. dollars)

	1972	1974	1975
Production	1.7	2.5	3
Imports	19.2	33.4	42
Exports	.4	.9	1
Market size[1]	20.5	35.0	44

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[1] Market size equals production plus imports minus exports. minus exports.

ter quality control work. In some industry sectors, notably pharmaceuticals, laboratory expenditures should rise beyond the level required to improve test and evaluation facilities. This increase in expenditures will permit the undertaking of additional basic research. Total laboratory expenditures by Spain's industrial corporations may climb from nearly $162 million in 1974 to $335 million in 1979. Purchases of laboratory instruments are likely to increase from about $16 million to $51 million during the same period.

Substantial sums are being spent to modernize and equip the laboratories of hospitals now being brought into the network of Spain's Instituto Nacional de Prevision (INP). National Social Security Institute. Expenditures by laboratories in Spain's medical facilities could total $48 million in 1979, compared to just over $19 million in 1974. Purchases of laboratory instruments are forecast at $7 million for 1979, reflecting average yearly growth of nearly 30% from 1974 levels.

Independent commercial laboratories are a fairly recent development in Spain. Approximately 65 such facilities are reported to have spent $8.7 million in 1974, of which $900,000 went for laboratory instruments. Projections for 1979 suggest that annual laboratory expenditures may reach $22 million, of which $3 million might be budgeted for instrumentation.

Competitive Environment

Spain's laboratories buy nearly all their instruments from foreign suppliers; imports valued at more than $33 million in 1974, supplied 95% of the market. Purchases abroad are expected to follow the trend of the market as a whole, rising by an average of 26% per year to exceed $106 million in 1979. Data on imports of selected items are presented in table 2.

U.S. manufacturers are estimated to have supplied $6.8 million, or just over 20% of Spain's laboratory instrument imports in 1974. In addition, significant quantities of instruments are manufactured by subsidiaries of American firms in Europe and Japan for shipment to this market.

Growing end-user interest in the more advanced models of laboratory instruments, including those suitable for interfacing with minicomputers, favors American firms, which are recognized as world leaders in the design and production of such equipment. U.S. companies also benefit from having secured the services of excellent local representatives. Nevertheless, some erosion of the U.S. share may occur during the next few years because of increasingly favorable tariff advantages enjoyed by members of the European Economic Community (EEC) and because minor third-country suppliers such as Japan, Sweden, Switzerland, and Finland are stepping up their sales promotion efforts in this market.

More than 20 American manufacturers regularly sell significant quantities of laboratory instruments to Spain. Four of these—Leeds & Northrup, Perkin-Elmer, Millipore Corp., and Honeywell— have set up sales subsidiaries in Spain. The others. such as Beckman Instruments, Coulter Electronics, Hewlett-Packard, Bird Electronic Corp., Data General Corp, Analog Devices, Inc, Houston Instrument, and American Optical, are represented by importer-distributors.

German manufacturers lead all other foreign suppliers of laboratory instruments to Spain. In 1973, their sales accounted for 23% of the market. Other supplier countries are France (with a 1973 market share of 12%), the United Kingdom (11%), Italy (8%), Switzerland (6%), Sweden (4%), and Japan (4%).

European manufacturers achieved their strong competitive position by selling basic instruments with features the Spanish user has come to prefer. Professional scientists and laboratory technicians have ample opportunities to become well acquainted with European-made instruments at trade shows and symposia held in Spain and elsewhere on the Continent. The fact that European suppliers normally provide catalogs and technical literature in the Spanish language gives them a measurable sales advantage in the eyes of the Spanish customer.

Among the European manufacturers actively selling laboratory instruments in the Spanish market, two major companies stand out for their strong marketing organizations that include local sales subsidiaries. Philips Gloeilampenfabrieken NV (the Netherlands) makes a variety of laboratory instruments in factories located throughout Europe. The Spanish subsidiary of Carlo Erba, of Italy. sells the products of its parent company in addition to acting as importer-distributor for a number of complementary lines of other manufacturers. Both firms are reported to be in a favorable position to challenge the American lead in the Spanish market for electronic laboratory instruments.

A list of other important European and Japanese suppliers of laboratory instruments to Spain would include B. Braun Apparateben, E. Hartnack. and Walter Herzog of Germany; Meci of France; Advance Electronic Ltd., Devices Instruments Ltd., and Todd Research Ltd. of the United Kingdom; Olivetti of Italy; Contraves AG of Switzerland; AGA Infare Systems AB and Haldex AB of Sweden; and Hitachi and Nippon Kogaku K.K. of Japan.

Spain's output of laboratory instruments in 1974 was a modest $2.5 million. Recently, new domestic enterprises have begun production and several U.S. and other foreign manufacturers have expressed interest in assembling or manufacturing laboratory instruments in Spain. However, producers will continue to concentrate on basic intruments, and subsidiaries of foreign firms are likely to export a substantial portion of their output, so the increased production is unlikely to have any significant effect on imports during the 1975-79 period. Output for 1979 is forecast at $6.8 million, of which as much as $2.4 million could be exported.

There are 29 small companies making laboratory instruments in Spain. Gri-Cel S.A., the leader with 1974 sales of $700,000, makes humidity meters, pH meters, photocolorimeters, flame photometers, electronic cell counters, coagulation rate meters, and spectrophotometers, as well as auxiliary equipment such as agitators, centrifuges, and digital readout attachments. Gri-Cel exported 12% of its 1974 production to EEC nations. Management expects the firm's sales to rise by 35% per year between 1975 and 1979.

Medilec S.A. began production of laboratory instruments designed by the Government's Nuclear Energy Junta Energia Nuclear (JEN), in 1974. Sales of such items as portable radiation counters, radiation monitors, scintillation counters, and gamma ray spectrometers are expected to reach $200,000 in 1975 and $400,000 in 1976. New products for both domestic and export markets will be added to the line each year.

MacLeod S.A., a branch of the giant importer-distributor Pacisa, has been quite successful in selling its air sampling devices (SO9x8 and particulate) to Spanish users. MacLeod is considering going into the production of pH meters and photometers.

Atom, a new company based in Barcelona, presently limits its activities to making power sources for electrophoresis and plans to expand its product line in the near future. Atom's 1974 sales were estimated at $100,000. Another small Barcelona firm, Crison Instrumentos Cientificos, which makes pH meters, is also regarded as having good growth potential; its 1974 sales were approximately $100,000.

Selected instrument markets.—According to research recently done in Spain for the Office of International Marketing, Bureau of International Commerce, the Spanish market for *gas chromatographs* should expand by 23% per year during the 1974-79 period (see table 3). Many large nonprofit research laboratories and some private industry laboratories will have to install multiple units to keep up with the volume of continuous, routine analysis. Buyers are turning from simple flame chromatographs to electron capture and complete systems coupled to mass spectrometers. An estimated 65% of the gas chromatographs sold in Spain in 1974 were of U.S. origin. The success of the chief supplier, Perkin-Elmer, is reported to be due to a well-organized sales, service, and training program. However, some European firms are manufacturing and aggressively promoting chromatographs that are said to be comparable to advanced U.S.-made models.

Table 2.—Spain: Imports of Selected Laboratory Instruments,1972-74

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Laboratory centrifuges for liquids			
United States	35	128	167
Germany	236	177	195
United Kingdom	4	14	22
France	7	2	1
Others	27	89	14
Total	309	410	399
Instruments and apparatus for physical or chemical analysis, not electrical or electronic			
United States	683	719	391
Germany	629	738	460
United Kingdom	264	292	139
France	227	243	125
Others	438	738	345
Total	2,241	2,730	1,460
Spectrographs, mass spectrometers, and chromatographs			
United States	298	1,179	1,512
Germany	122	800	438
United Kingdom	286	1,023	435
France	474	495	21
Others	286	624	658
Total	1,466	4,121	3,064
Scintillation counters			
United States	186	382	244
Germany	6	20	21
United Kingdom	3	11	10
France	13	15	2
Others	82	15	34
Total	290	443	311

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[1] January—June, 1974 only.

Source: Direccion General de Aduanas, Ministerio de Hacienda.

Demonstrations and lectures given at an international symposium held in Barcelona in 1974 sparked user interest in the possible applications of various types of *liquid chromatographs*. At present, buyers seem to be opting for the automated liquid column system because of the shortage of skilled laboratory technicians. Sales of liquid chromatographs should exceed $1.2 million in 1979, of which perhaps 30% will be supplied from the United States. Perkin-Elmer, whose liquid chromatographs are manufactured in Japan, and Philips are the sales leaders.

Market analysts report that a substantial number of end users plan to buy *mass spectrometers* in the near future, although relatively few are presently used in Spanish laboratories. These instruments will often be purchased in conjunction with gas chromatographs or for adding to existing chromatographs. Compatibility with minicomputers is also an important consideration. In general, Spanish buyers consider U.S.-designed electronic instruments to be superior for converting or upgrading existing instruments. Hitachi manufactures

Table 3.-Spain: Sales of selected laboratory instruments, 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total	United States	Total	United States
Gas chromatographs	350	228	990	540
Liquid chromatographs	400	120	1,270	380
Mass spectrometers	283	57	800	200
NMR spectrometers	69	17	190	60
pH meters	270	81	760	190
Densitometers	150	30	420	80
Thermal analyzers	140	28	390	80
Colorimeters	390	117	1,100	270
Refractometers	360	90	1,010	250
Electron microscopes	824	247	2,620	790

Source: Values based on Spanish trade source estimates.

mass spectrometers under license from Perkin-Elmer, the market leader.

Demand for ***nuclear magnetic resonance (NMR) spectrometers*** should begin to develop as Spain's pharmaceutical manufacturers and large nonprofit research laboratories expand their research programs. Japanese-made NMR spectrometers marketed in Spain by Perkin-Elmer accounted for most of 1974's $69,000 in sales.

The increase in the number of small laboratories in the food processing industry and in the air and water pollution control field should keep the Spanish market for ***ph meters*** expanding at about 23% per year. The interest of most users in replacing old models with new ones featuring digital readouts is also a factor in sustaining demand. Domestic manufacturers have a 20% share of the market.

The expected increase in the number of new laboratories should boost sales of ***densitometers*** by an average of more than 20% per year. Isotope densitometers—for which the United States is regarded as the design leader—are expected to be used increasingly. Densitometers are among the few laboratory instruments manufactured in quantity in Spain. Domestic makers of simple density balances account for about 20% of sales.

Thermal analyzers are not yet in general use in Spain; however, there should be a steady growth in sales of thermal analysis equipment. The distribution of technical literature describing procedures and emphasizing the advantages of this type of instrument could be a significant stimulus to further sales.

Demand for ***colorimeters***, especially direct digital readout photoelectric models, is reportedly very strong. Spanish manufacturers, selling at relatively low prices, are expected to be able to raise their share of colorimeter sales from 15% in 1974 to 20% in 1979, largely at the expense of American suppliers.

Market analysts report that ***refractometers*** are in use in more than half of Spain's laboratories. No single firm dominates this market, but in general, American manufacturers face stiff competition from German and Japanese makers of optical goods. ***Electron microscopes*** have recently become very popular with Spanish scientists. Sales are expected to climb by an average of 26% per year, reaching $2.6 million in 1979. The Spanish user's traditional preference for German-made optical instruments has made Carl Zeiss the market leader, but Philips and Perkin-Elmer (whose U.S.-designed electron microscopes are made under license in Japan by Hitachi) also enjoy substantial market shares.

Major Purchasers

Spain's economic policymakers have determined that an increase in the country's R&D outlays to a level equivalent to 2% of the gross national product is needed to set the country's industry on the road to greater technological independence. Officials consider that such a level could be reached by 1980. Research and development expenditures between 1974 and 1979 should rise from $683 million to nearly $2 billion, an average rate of 24% per year. Areas likely to draw substantial R&D funds during the next few years are the environment, nuclear energy, electronics, biomedicine, and industrial production processes.

The Government provides 85% of the funds used for R&D in Spain. Moreover, the Government strongly influences the way in which industrial R&D budgets are spent, since most private sector projects are subsidized by the Government and subject to advance approval. Educational and nonprofit research institutes are administratively autonomous but depend almost entirely on government or industry research contracts.

In 1974 government laboratories used 68% of the available R&D funds, while private companies and industry associations spent 26%. Educational and nonprofit research institutes expended 6% of Spain's R&D outlays (see figure 2). These relationships are expected to continue essentially unchanged during the balance of the decade.

Well over 13,000 persons are employed as scientists, engineers, and technicians in the physical and life sciences in Spain, according to 1974 data (see table 4). Not all of these are employed on a full-time basis, and a substantial number occupy administrative posts. Approximately 35% of the nearly 5,300 scientists hold advanced degrees and slightly more than half the 1,690 engineers have been educated beyond the Bachelor of Science level. Virtually all personnel received their training in Spain; it is not common for students to go abroad to study the physical sciences or for foreign professors and research scientists to find employment in Spain.

The Spanish Government recognizes that the nation's reserve of trained scientists and technicians is inadequate to carry out the R&D programs that are already planned. An example of this concern was the inclusion in the Third Development Plan (1972-75) of $18 million for scholarship grants and nearly $36 million in aid to higher education. Improvement in the training and utilization of laboratory technicians is expected.

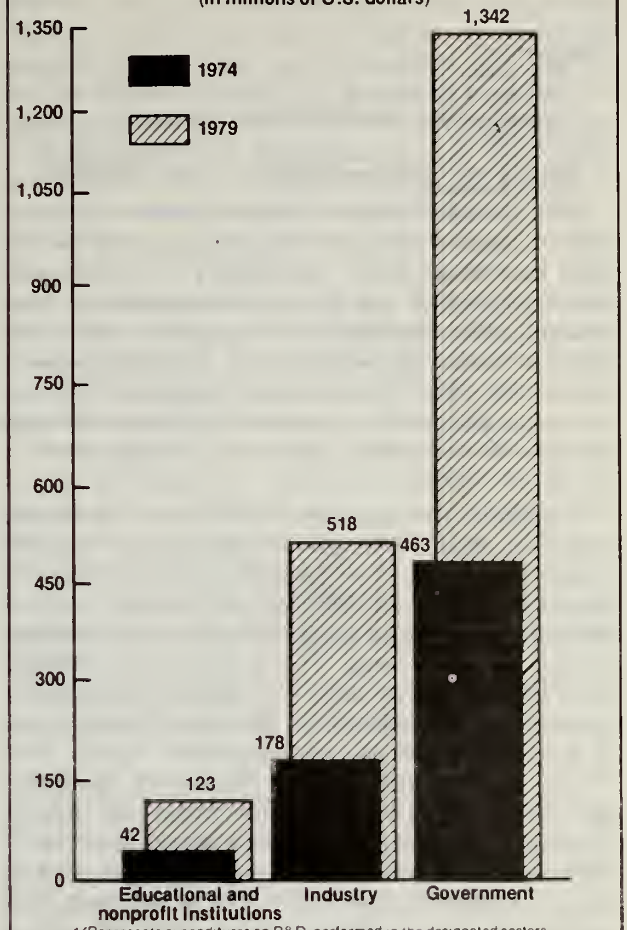
Government laboratories.—The responsibility for directing and funding Spain's research and development work rests almost entirely with the central Government. Most of the Ministries at the federal level have large departments that plan and oversee such projects. A committee of high-ranking representatives from each Ministry—the Comite Ejecutivo de Investigacion Tecnologica (Executive Committee for Technological Research)—coordinates the various programs. R&D expenditures under the control of the Executive Committee totaled nearly $134 million in 1972. The largest sums were spent by the Ministry of Industry ($59 million), the Ministry of Education and Science ($22 million), and the Ministry of Agriculture ($21 million). Outlays from a general fund administered by the Office of the President amounted to $8.4 million, excluding administrative costs.

Estimates for 1974 indicate the government use of R&D funds, including ministerial budgets, monies allocated under the Third Development Plan, funds from various other sources, and combined administrative costs exceeded $462 million. Forecasts for 1979 suggest that $1.3 billion may be spent for research and development done in laboratories directly administered by the Spanish Government; the budget for laboratory instruments is $30 million for that year (see table 5). Major research programs necessitating the expansion of such laboratories during the 1975-79 period, however, will not be announced until the details of the Fourth Development Plan are made public.

JEN, the Nuclear Energy Commission, is the largest single scientific research and development complex administered by the Spanish Government. The Commission received $20.8 million in 1972 from the Ministry of Industry and is estimated to account for 20% of government sector laboratory expenditures. Spain is counting on nuclear energy from domestic uranium to meet its soaring requirements for electricity. Three nuclear power plants, with a combined output of 1.1 million kilowatts, are already functioning and six more are scheduled to be operational by late 1978. JEN's first uranium concentration plant produced the equivalent of 75 tons of U-308 in 1973; two more concentration plants are under construction.

JEN is constantly engaged in research and development on the production and application of atomic energy. The Fourth Development Plan is expected to call for significantly increased investments in JEN's endeavors, now that the basic research facilities are in operation. JEN is well staffed by technicians who were sent to study at atomic research and production centers in the United States, France, and England. Some of JEN's current R&D projects concern development of a high-speed nuclear reactor, medical use of isotopes, desalinization of sea water, irradiation of foods, experimental use of atomic tracers in botanical studies, and design of equipment to detect and measure radiation.

Figure 2. Spain: R&D expenditures,[1] 1974 and 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the original source of the funds.

Source: Values based on Spanish trade source estimates.

Some 425 scientists, including approximately 150 chemists and 100 physicists, are employed at JEN laboratories. The instruments they use, valued at $1.5 million, include gamma ray spectrometers, radiation counters, and scintillation detectors developed by JEN's own scientists. In addition, these laboratories are equipped with such instruments as gas chromatographs linked to mass spectrometers, thermal differential analyzers, X-ray (fluorescence) analyzers, and electron microscopes.

Aside from the JEN facilities, the largest government laboratories are those operated by the Army, the Navy, and the Oceanographic Institute, each of which is equipped with at least $150,000 in laboratory instruments. Actually, the bulk of the military weapons R&D is done by government-owned companies under contract from either the Army or the Navy. For example, the Empresa Nacional Santa Barbara de Industrias Militares S.A. is developing a version of the multibarreled Gatling gun for antiaircraft defense use. The

Table 4.—Spain: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

Employed by:	Scientists	Engineers	Technicians
Goverment	2,820	430	2,850
Industry	1,230	1,130	3,090
Educational and nonprofit institutions	1,240	130	440

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[1] Includes scientists whose responsibilities are primarily administrative.

[2] Includes field personnel.

Source: Values based on Spanish trade source estimates.

radar-controlled computerized aiming system for this gun was designed at the Army's own Ordnance Laboratory, which is staffed by 88 engineers and scientists and 319 technicians. Oceanographic research projects are normally contracted to nonprofit research laboratories. The Oceanographic Institute, however, maintains laboratories aboard research ships operating in the Mediterranean and the coastal waters of northwest Africa.

The Ministry of Agriculture spends most of its R&D budget on field work; agricultural research is usually either contracted to or performed independently by nonprofit research laboratories. The Ministry's regional laboratories have only simple instruments such as those needed for soil testing. The Hydrobiology Division, however, has a fairly large and modern laboratory for monitoring water taken from lakes and streams as part of a contamination control program.

Only the laboratories of the Ministry of Agriculture and the Geology Division of the Ministry of Industry are considered likely to make significant use of electronic data processing technology as applied to laboratory work during the 1975-79 period. Both these agencies perform a large number of routine analyses that could be handled efficiently by high-speed chromatographs, spectrophotometers, and polarimeters. Laboratory instruments which market analysts believe will be of particular interest to government sector users during the 1975-79 period include:

Electron diffraction analyzers
Isotope analyzers
Gas chromatographs
Electron microscopes
X-ray diffractometers
Scintillation counters
pH meters
Colorimeters
Refractometers
Turbidimeters

Educational and nonprofit research laboratories.—Spain's 144 educational and nonprofit research laboratories provide a very promising market for the sale of advanced electronic laboratory instruments. Most of the country's basic research is performed at these well-equipped, modern facilities, which, although almost wholly government-funded, are administered by the autonomous Consejo Superior de Investigaciones Cientificas (High Council for Scientific Research).

Data on the Council's total annual budget are not available; trade sources estimated its 1974 laboratory expenditures at $43.2 million. Most of the Council's financial support comes from the Ministry of Education and Science, but the 4-year Development Plans and various other government programs provide additional funds.

There are seven semiautonomous foundations administered by the Council. Four of these are concerned with the natural sciences. All the laboratories and groups of laboratories within these foundations contract to do research for government organizations and private industry associations, and they also study topics selected by the Council itself. These research centers are vital training grounds for students of the natural sciences and, as such, an important tool in Spain's efforts to develop a reserve of skilled scientific manpower.

The Juan de la Cierva foundation, dedicated to applied research in industry and agriculture, is by far the most important laboratory group administered by the Council. This foundation receives 50% of the Council's annual budget in addition to substantial grants for studies to be made in connection with the Development Plans. The Juan de la Cierva foundation's 32 laboratories are housed at 24 sites and staffed by some 445 scientists and 650 technicians. In general, each of the laboratories specializes in a particular industry sector and receives financial backing from that industry's trade association.

Three of the largest laboratories within the Juan de la Cierva foundation are the Instituto de Agroquimica y Tecnologia de Alimentos (Institute of Food Chemistry and Technology), the Instituto de Investigaciones Pesqueras (Institute for Fisheries Research), and the Instituto Nacional del Carbon y sus Derivados (National Institute of Coal and Coal By-products).

The Institute of Food Chemistry and Technology in Valencia is located in the heart of Spain's fruit and vegetable growing region. Many of its projects—such as product and process development, equipment design, and the elaboration of standards—are commissioned by the Government-sponsored fruit and vegetable canners' research association, for whom the Institute also performs test and evaluation services. Basic research is done on a continuing basis in the fields of biochemistry, microbiology, and enzymology. The laboratory facilities of the Institute for Food Chemistry and Technology are well equipped and include a substantial number of U.S.

made instruments. The increased research grants expected to be made available under the Fourth Development Plan and the test and evaluation work required under the recently enacted Codigo Alimentario (Food Laws), however, will greatly expand the workload.

The Institute for Fisheries Research has its main office and laboratories in Barcelona and branch laboratories in Cadiz and Vigo. These three facilities together have installed over $1 million worth of instrumentation in order to perform both chemical and biological analyses. The emphasis is on marine biology; 53 of the 69 scientists on the staff are biologists. The Institute's current projects include the study of sea life on the continental shelf off Spanish Morocco with a $5.4 million grant received under the Third Development Plan, the monitoring of pollution in commercial shellfish beds, and applied research and quality control for the seafood packing industry. The Institute expects substantial increases in work done under contract to the packing industry during 1975-79; in this connection it may be necessary to buy a high-speed atomic absorption spectrophotometer with digital readout.

Significant purchases of laboratory instruments are also entailed in the Fisheries Institute's construction of a new facility at Las Palmas in the Canary Islands and in the equipping of a laboratory in a new oceanographic research ship. The Institute's total 1976 purchases of laboratory instruments are forecast at $880,000, including $350,000 for the Las Palmas center and $200,000 for the research ship laboratory.

The National Institute for Coal and Coal By-Products, with research centers at Oviedo and Zaragoza, was initially established to analyze and classify Spain's extensive coal deposits. Now, however, its efforts are concentrated on finding an economical way to desulfurize low-grade domestic coal. The Spanish steel industry must import large quantities of low-sulfur anthracite from abroad, and the Government wants to reduce this drain on foreign exchange reserves. Moreover, the public is becoming aware of the polluting effects of sulfur dioxide emissions by electrical powerplants and other users of domestic coal. The recent rise in the world price of petroleum has lent new urgency to another Coal Institute research project, that of obtaining oil or gas from domestic coal. The Fourth Development Plan is almost certain to include a generous increase in grants for this program.

The three other scientific research foundations that come under the jurisdiction of the Council all have much smaller budgets than has the Juan de la Cierva. The Alonso de Herrera foundation specializes in plant diseases and botany. This organization, with 26 regional laboratories employing 234 scientists and 472 technicians, does most of its research in the field.

The Santiago Ramon y Cajal foundation works closely with the University of Madrid medical school and specializes in microbiology and virology. This foundation's seven laboratories employ more than 120 scientists and nearly 150 laboratory technicians, most on a part-time basis. Roughly half these employees are graduate students working on projects for their doctoral degrees.

The Alfonso el Sabio foundation was established to set up and administer the research facilities used for the study of mathematics, natural science, and medicine at Spain's 18 universities. At present, there are 79 on-campus laboratories in this category. The more than 200 scientists working at these laboratories are normally drawn from the ranks of university professors. Most of the approximately 100 technicians are students.

The educational and nonprofit research laboratories tend to use the most advanced and sophisticated instruments available. By grouping some of the laboratories together, they can share instruments and repair services

Table 5.—Spain: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Laboratory expenditures		Purchases of laboratory instruments	
	1974	1979	1974	1979
Government	97.9	244	9.8	30
Educational and nonprofit institutions	43.2	107	6.5	20
Independent commercial laboratories	8.7	22	.9	3
Medical organizations	19.3	48	1.9	7
Industry:				
Oil and gas extraction	—	—	—	—
Food products	11.0	23	1.7	6
Chemicals	23.2	48	3.5	13
Petroleum	3.5	7	.5	2
Rubber and plastic products	5.8	12	.6	2
Stone, clay, and glass	4.4	9	.4	1
Primary metals	16.4	34	1.6	5
Fabricated metal products	38.5	80	3.7	11
Transportation equipment	37.6	78	1.8	5
Other	21.2	44	2.1	6
Total	330.7	756	35.0	111

Source: Values based on Spanish trade source estimates.

which helps to justify the purchase of more costly and complex items.

The practice of interfacing existing instruments with minicomputers is not being readily adopted by the nonprofit laboratories. Nevertheless, in the near future laboratories working for the food processing industry may have to install computer systems that yield simultaneous readouts of several analytical functions. Because of the new food laws, the workload of test and evaluation laboratories will increase. The need for speedier results obtained from sophisticated equipment will rise.

Some of the instruments most likely to be purchased by Spain's educational and nonprofit research laboratories during the 1975-79 period are:

Gas chromatographs interfaced with mass spectrometers
High-pressure liquid chromatographs
Electron microscopes
Refractometers
Infrared spectrometers
Atomic absorption spectrophotometers

Laboratories in the chemicals industry.— Spain's chemicals industry experienced spectacular expansion in recent years; at one time annual sales increases were averaging 20%. Growth now seems to be stabilizing at a healthy 13% per year. Output, valued at almost $6 billion in 1973, is forecast at more than $12 billion for 1979. Capital investment is rising somewhat more rapidly—by about 15% annually—than production and may top $330 million in 1979. Purchases of laboratory instruments could nearly quadruple, climbing from $3.5 million in 1974 to $13 million in 1979.

The pharmaceuticals sector of the chemicals industry accounts for approximately 25% of sales and is noteworthy for its heavy investment in research and development. Whereas the average firm in Spain's national list of the 500 largest corporations spent only .5% of 1972 income on R&D, four drug manufacturers are recorded as having spent from 7% to 8.3% of income on such work. The smaller pharmaceuticals firms are expected to follow the example of industry leaders.

The laboratory facilities at Dr. Andreu S.A., of Barcelona, are fairly typical of those operated by the three other leading domestic drug makers (Dr. Esteve S.A., Laboratorios Ferrer, and M.A.D.E.). Most of the studies performed concern antibiotics and vaccines. Of the laboratory instrumentation, valued at approximately $650,000, nearly half is American made. The laboratory's staff comprises 10 biologists, 7 chemists, 6 pharmacists, a biochemist, and 16 technicians. Dr. Andreu S.A. expects to spend $175,000 annually for laboratory instruments during the 1976-79 period. Another manufacturer is reportedly ready to raise its investment in laboratory instruments from its present level of $350,000 to $1.2 million by 1977.

The petrochemicals industry also maintains a number of well-equipped laboratories, used generally for process and quality control. At the government-owned Empresa Nacional del Petroleo S.A., however, basic research on such topics as high-pressure, high-temperature lubricants, and coal desulfurization accounts for 40% of the workload. The staff of 32 chemists works with instruments valued at more than $3 million.

Chromatography is probably the analytical method most commonly employed in Spain's chemicals industry laboratories. Interest in buying more advanced models of chromatographs, particularly integrated and compound systems, has increased markedly since 1974 when the 10th International Symposium on Chromatography was held in Barcelona. Minicomputers for interfacing with existing laboratory instruments are also attracting user attention, but few sales have been made to date. Add-on digital readout units are being bought in significant volume.

Laboratory instruments offering particularly promising sales opportunities to suppliers of the Spanish chemicals industry include:

Gas chromatographs linked to mass spectrometers
Liquid column automated chromatographs
Amino acid analyzers
Carbon, nitrogen, hydrogen analyzers
Oxygen analyzers
Radiochromatographs
Polarimeters
X-ray diffractometers

Laboratories in the food processing industry.— Agriculture and fishing have historically been cornerstones of the Spanish economy. The food processing industry is now the largest single contributor to the nation's gross industrial product. Sales of foodstuffs, beverages, and canned or frozen seafood totaled $9.4 billion in 1972. The industry has grown at a steady annual rate of 9% during the past decade and is expected to expand at a similar pace during the remainder of the 1970's.

Capital investment in food processing is rising even more rapidly than sales; if the current 14% growth rate is maintained, investment will total $197 million in 1979, more than double 1973's level of nearly $90 million. Capital outlays have been increased to cover the expansion and modernization of small and medium-size processing plants as well as the construction of new facilities and reequipping of older factories to produce the convenience foods now in demand by both domestic and export markets.

Sales of laboratory instruments to individual food processors will undoubtedly be stimulated by enforcement of recently enacted food purity standards. Under pressure to provide foreign customers with consistently high-quality foodstuffs, Spanish packers and processors of olive oil, fruits, vegetables, and other exportable foods are stepping up their quality control procedures. The industry's laboratory expenditures could more than double between 1974 and 1979, reaching $23 million at the end of the period; purchases of laboratory instruments are expected to total $6 million in 1979 compared with $1.7 million in 1974.

Research and development in the Spanish food industry deals mainly with processing and packaging methods. Most of the work is performed on a contract basis by the nonprofit research laboratories. Partial funding for these studies is provided by individual companies through their trade associations; the Government makes up the difference through direct grants to these associations. R&D expenditures by 34 of Spain's largest food packers and processors are estimated to have totaled $2.5 million in 1972.

Laboratory instruments that are most salable to firms in Spain's food industry between 1975 and 1979 include the following:

Compound optical microscopes
pH meters
Balances
Saccharimeters
Nephelometers
Colorimeters
Gas chromatographs

Trade and Technical Regulations

Import duties on U.S.-origin laboratory instruments brought into Spain range from 1% to 32.5%. An additional tax from 2% to 12% is levied to compensate for the value-added and turnover taxes paid by domestic manufacturers of laboratory instruments. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The characteristics of Spain's electrical power supply are 220 volts, 50 hertz, single phase; 220-, 380-, and 500-volt, 3-phase installations are also available. A significant number of older industrial plants operate on 125-volt, 50 hertz current. The metric system of weights and measures is the statutory standard in Spain.

The Government of Spain is revising its technical and safety standards in order to bring them into harmony with those of the European Economic Community. American manufacturers should have no difficulty in meeting the revised standards. Information on the availability of published standards for laboratory instruments in Spain may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Spain is available on a continuing basis from:

Country Marketing Manager-Spain
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

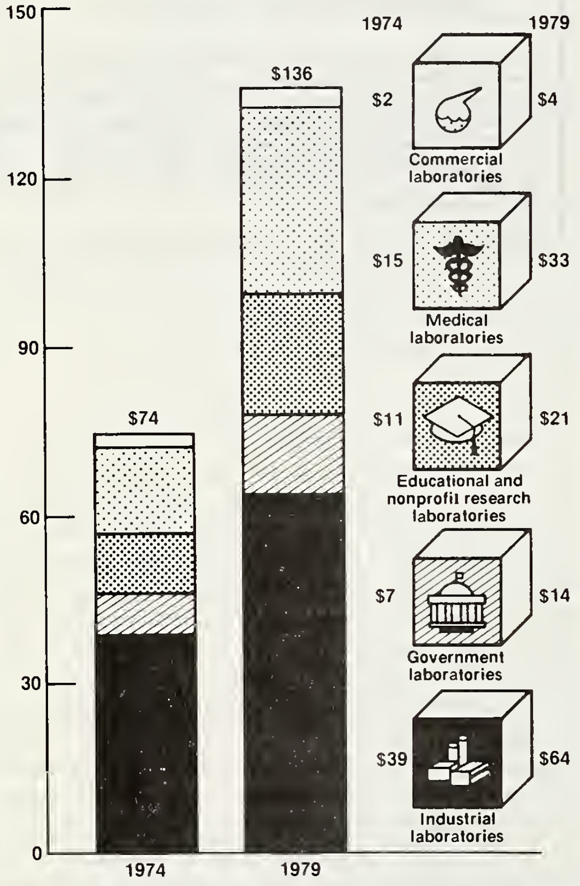
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments— Spain," DIB 75-05-500, February 1975.

Sweden

The equipping of new laboratories to be constructed at Sweden's universities and regional hospitals, together with measures to be taken in all end-user sectors to accommodate computer technology, should increase the country's expenditures for laboratory instruments by a yearly average of 13% during the 1974-79 period. The market is projected to reach $136 million[1] for 1979 compared with $74 million in 1974 and an estimated $85 million in 1975 (see table 1). Sales rose unusually sharply—by an average of 27% per year—between 1972 and 1974.

Figure 1. Sweden: Sales of laboratory instruments to major end-user sectors 1974 and projected 1979 (in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research report. Values based on Swedish trade estimates.

Laboratory expenditures totaling more than $163 million for all user sectors are forecast for 1979, with the greatest expansion taking place in the fields of medicine and education. The attention given preventive medicine under Sweden's government-financed health care program has been a factor in the plans made by authorities for new or enlarged laboratory facilities at many hospitals. Purchases of instruments for these and other medical laboratories may more than double during 1974-1979, reaching $33 million at the end of the period (see figure 1).

The Swedish Government is attempting to induce more students to enter scientific and technical fields of study. Accordingly, sales of laboratory instruments to educational institutions (including purchases by nonprofit research organizations) are expected to rise by an average of almost 14% per year from 1974's level of $11 million, to $21 million in 1979.

Companies in Sweden's chemicals, primary metals, and pulp and paper industries are likely to concentrate their purchases on instruments suitable for use with computers and on routine replacement or limited upgrading of their present equipment. Sales of laboratory instruments to the industrial sector are forecast to climb by more than 10.5% yearly to reach $64 million in 1979, compared with $39 million in 1974.

Government agencies indicate that their spending for laboratory instruments may exceed $14 million in 1979, double their 1974 outlays. A twofold increase is also predicted for sales to commercial laboratories; this user group may invest almost $4 million in laboratory instruments in 1979.

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[1] All values shown in U.S. dollars. Local currency converted at the following exchange rates: U.S. $1.00 = SKr. 4.76 (1972), SKr. 4.36 (1973), SKr. 4.40 (1974 and subsequent years).

Table 1—Sweden: Size of market for laboratory instruments, 1972, 1974, and estimated 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	25.1	41	47
Imports	38.2	65	75
Exports	17.3	32	37
Market size[1]	46.0	74	85

[1] Market size equals production plus imports minus exports.

Source: Values based on official statistics and Swedish trade source estimates.

Competitive Environment

Swedish laboratories buy most of their instruments from foreign suppliers; the domestic industry, although well developed, ships most of its production to export markets. In 1973, imports totaled $50.8 million, or 86% of consumption. Purchases abroad will continue to follow the trend of the market as a whole, rising by an average of 13% per year from 1974's $65 million to reach $120 million in 1979. Data on imports of selected items are presented in table 2.

United States manufacturers are estimated to have supplied 24%, or $15.6 million of Sweden's laboratory instrument imports in 1974; this figure represents a significant increase over that for 1972, when sales by American firms amounted to $8.5 million or 22.3% of the import market. U.S. technological strength in electronic laboratory instruments, coupled with its well-developed, active network of Swedish sales agents, should help boost sales to $31 million, or 26% of imports by 1979.

Major U.S. suppliers of laboratory instruments to Sweden, include American Instrument Co. (selling fluorometers); Beckman Instruments (spectrometers, electrophoresis devices, pH meters); Finnigan Instrument Corp. (mass spectrometers); Searle Nuclear (chromatography); Tektronix (oscilloscopes); Turner Associates (fluorometers, photometers); and Varian Associates (nuclear magnetic resonance spectrometers, and ultraviolet and visible spectrophotometers).

West German firms currently supply most of Sweden's imported laboratory instruments. However, their share (35% in 1973) of the import market was reported to have fallen somewhat in 1974 and could drop further in 1975. Trade analysts regard this loss as only temporary; by improving their lines of electronic laboratory instruments, West German manufacturers should be able to bring their percentage of the market back up to the 1973 level. The key items imported from West Germany are electrical measuring instruments, X-ray analysis equipment, conventional and electron microscopes, spectrometers, and chromatographs.

Some principal West German suppliers of laboratory instruments to Sweden are Siemens (chromatographs, electron microscopes, electrical measuring instruments); Endress & Hauser (pH meters, hygrometers); Hertel & Reuss (microscopes); Knott (oscilloscopes); and Leitz (measuring instruments.)

The United Kingdom has been a major seller of electrical and electronic laboratory instruments to Sweden, but the U.K. share of this market is reported to have declined from its 1973 level of 12%, and analysts are not optimistic that British sales will soon recover. Liquid analysis equipment, hygrometers and indicators, recorders, and controllers for laboratory use are the instruments with which the United Kingdom has had the most success in the Swedish market. Pye Unicam and Shaw Moistures are leading suppliers.

Manufacturers from several other European nations have been highly successful in selling specific types of laboratory instruments to Sweden. Such companies include Radiometer of Denmark (pH meters); Philips (chromatographs) and Cenco (laboratory centrifuges, refractometers), both of the Netherlands; the Swiss firm of Mettex (laboratory scales) and Hasler (viscometers); Zeiss, of East Germany (microscopes, chromatographs, photometers, X-ray diffractometers); and Reichert of Austria (microscopes, microtomes).

Specializing in conventional and electron microscopes and in X-ray analysis equipment, Japan is becoming increasingly successful in selling laboratory instruments to Sweden. The Japanese share of the market amounted to 5% of total 1973 imports; the percentage is reported to have been rising since then and should continue to climb, at least through 1979. Some leading Japanese suppliers to this market are JEOL (electron microscopes, X-ray analysis equipment); Olympus Optical (microscopes); Hitachi (spectrophotometers); Shimadzu Seisakusho (spectrophotometers, spectrofluorimeters); and Jasco Syntex (spectropolarimeters).

Swedish production of laboratory instruments expanded rapidly during the early 1970's. Between 1972 and 1974, for example, output jumped from $25 million to $41 million or by an average of 28% per year. The additional goods were fully absorbed by world markets; 1974 exports (including reexports) amounted to $32 million.

Local industry's future growth depends mainly on the demand for mechanical and electrical instruments for physical and chemical analysis on the part of laboratories in other Scandinavian countries, West Germany, and East European nations. Swedish manufacturers have not been successful in developing a line of technologically sophisticated electronic laboratory instruments. The outlook for 1974-1979 suggests that both production and exports will continue to rise, but at a more moderate pace than has been recorded during the first half of the decade.

Sweden's laboratory instruments industry is characterized by the participation of numerous small firms. Of the 58 companies rated as significant producers, 6 account for half the total sales. Some leading manufacturers, are LKB-Produkter (with sales of $6 million); AGA($3 million); Bofors Elektronik ($3 million); Ljungstrom ($2 million); and Stathmos-Linden ($2 million). The industry's principal products include chromatographs, electric measuring equipment, scales, centrifuges, pH meters, and oscilloscopes.

Subsidiaries or licensees of foreign manufacturers are reported to have accounted for approximately one-third of Sweden's 1973 production of laboratory instruments. The major companies in this category are Honeywell, Svenska (United States); the Philips Industrielektronik-Division of Philips, Svenska (the Netherlands); and Siemens, Svenska (Germany). Honeywell sells approximately $1.5 million annually in gas analyzers and accelometers. Philips, with $4.5 million in laboratory instrument sales, manufactures oscilloscopes, chromatographs, spectrometers, ohmmeters, and pH meters in its Swedish factory, Siemens makes microscopes, X-ray spectrometers, and X-ray diffractometers for annual sales of approximately $3 million. Analysts foresee no significant change in the role of subsidiaries in Sweden.

Selected instrument markets.—Research recently conducted in Sweden for the U.S. Department of Commerce, Office of International Marketing, analyzed the market for 10 selected instruments.

The development of new applications for ***gas chromatographs***, particularly as used in connection with mass spectrometers (GC/MS), is inducing Swedish laboratories to replace their older model chromatographs with more sophisticated types. At present, users are said to prefer electron capture detecting chromatographs to the flame ionization types. Total sales of imported and domestically manufactured gas chromatographs are expected to nearly double during the next few years, reaching $2.2 million in 1979 compared with $1.2 million in 1974 (see table 3). American laboratory instrument makers, whose reputation in GC/MS is already well established, should be able to boost their share of Sweden's gas chromatograph purchases to almost 23%. Siemens and Philips are the United States' principal competitors in this market.

Liquid chromatographs are experiencing a resurgence in popularity because of the development of high-performance models (HPLC) and of new detection methods. Sales may double during the 1974-79 period, amounting to $1.2 million at the end of the period. American manufacturers should be able to capture 25% of 1979 sales, but Sweden will continue to import substantial quantities of liquid chromatographs from Zeiss.

Sales of both ***mass and nuclear magnetic resonance (NMR) spectrometers*** to Swedish laboratories are expected to increase substantially during the next few years because of widening applications in the pharmaceuticals industry, in medical laboratories, and in basic chemistry. Moreover, the rapid development of new, improved instrument designs will stimulate purchases by laboratories in the educational and medical sector. American spectrometer-makers, well established in the Swedish market, may be able to improve their already strong competitive position. Siemens is the chief competitor of U.S. firms in the Swedish market for mass spectrometers.

Table 2.—Sweden: Imports of selected laboratory instruments, 1972-1974

(in thousands of U.S. dollars)

	1972	1973	1974[1]
Centrifuges			
United States	213	279	114
West Germany	213	372	318
United Kingdom	300	232	70
Italy	—	90	60
Other	210	90	110
Total	936	1,063	672
Instruments and apparatus for physical or chemical analysis[2]			
United States	399	391	408
West Germany	420	506	720
United Kingdom	273	368	240
Switzerland	126	161	120
Other	315	575	336
Total	1,533	2,001	1,824
Electrical/electronic measuring and analyzing instruments[2]			
United States	7,959	9,108	12,192
West Germany	9,723	12,880	11,256
United Kingdom	5,313	5,888	6,696
Japan	1,239	1,909	1,896
Other	8,799	11,569	11,712
Total	33,033	41,354	43,752

[1] January-September.
[2] Includes some instruments not used in laboratories.
Source: Official Swedish foreign trade statistics.

The market for ***thermal analyzers***, especially calorimeters for research and for the clinical study of enzyme reactions, is forecast to expand at an average yearly rate of 20% from its 1974 base and to total $4 million in 1979. Differential thermal analysis and procedures involving calorimetry are increasingly employed in the chemicals industry, with microcalorimetry preferred to liquid or high-temperature calorimetry. Moreover, thermal analyzers are coming into wider use in Swedish universities and secondary schools. American manufacturers should be able to better their 31% share of the 1974 market in 1979, primarily because of their excellent, local representation.

The rapidly growing need to efficiently perform a series of analyses (as, for example, in hospital laboratories) and the recent technological innovations in photometry are factors in the projected jump in Swedish purchases of ***automatic analyzers*** from $3.5 million in 1974 to $8.7 million in 1979. American manufacturers should be able to maintain or increase their share (nearly 30% in 1974) of this market.

Sweden's laboratories are expected to more than double their purchases of ***electron microscopes*** between 1974 and 1979, raising sales of such instruments beyond the $3 million level at the end of the period. Siemens and JEOL are Sweden's chief suppliers of these instruments, which are increasingly needed by pharmaceuticals manufacturers in their research and

Table 3.—Sweden: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	1974		1979	
	Total	**U.S.**	**Total**	**U.S.**
Gas chromatographs	1.2	.2	2.2	.5
Liquid chromatographs	.6	.1	1.2	.3
Mass spectrometers	.9	.5	1.5	.9
NMR spectrometers	.8	.3	1.8	.7
pH meters	1.0	.2	1.2	.3
Densitometers	.5	.1	.6	.1
Thermal analyzers	1.6	.5	4.0	1.3
Automatic analyzers	3.5	1.0	8.8	2.6
Electron microscopes	1.5	—	3.1	—
X-ray analysis equipment	.8	.1	1.5	.1

Source: Values based on Swedish trade source estimates.

development (R&D) work and by medical laboratories with a heavy workload in the areas of immunology and pathology. Swedish scientists have expressed a preference for sweep-electron microscopes over other types.

Swedish purchases of *X-ray analysis equipment* are projected at $1.5 million for 1979 compared with $800,000 in 1974. The X-ray fluorescence technique, preferred over emission spectography, is in increasing use in Sweden's metals industry and in organic chemistry. JEOL is the main supplier.

Major Purchasers

Swedish expenditures for R&D in all fields of inquiry are expected to top $1.5 billion in 1979, reflecting an average annual increase of 13% from 1973's total outlays of $740 million. It is estimated that 10% of the sums appropriated for R&D ultimately become laboratory expenditures. Energy, the environment, and nutrition as areas likely to draw particularly large shares of future R&D budgets. There should be substantial increases in funds for projects directed toward developing additional domestic sources of energy and making the use of industrial and residential energy more efficient. Research on environmental problems will concentrate on light industrial pollution, noise pollution, and solid waste disposal. Scientists in the field of nutrition will stress studies of proteins and enzymes.

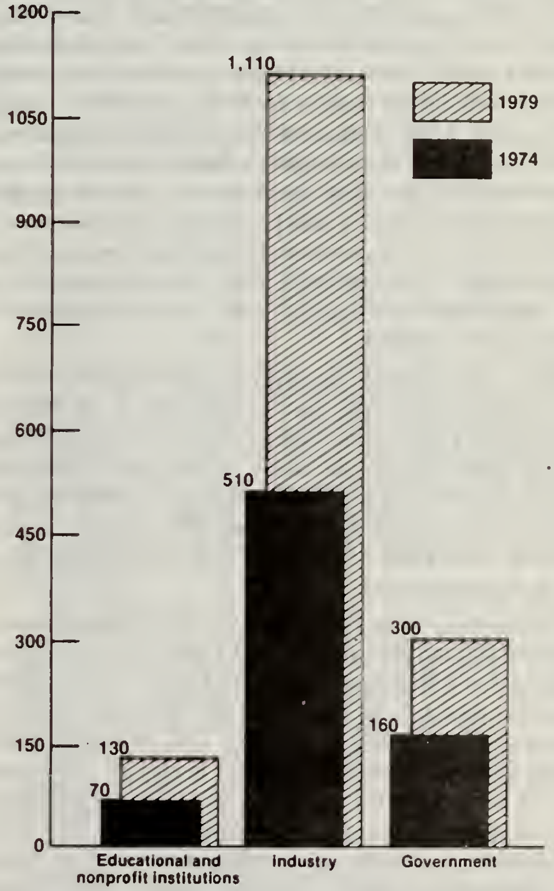
In Sweden, private industry provides most of the financial support for research and development. The industrial sector supplied over 57% of R&D funds in 1973 and may provide more than 60% of such monies in 1979. Additional sums obtained under government programs enabled industry to utilize 69% of the country's total 1973 R&D budgets; this portion will probably exceed 72% in 1979 (see figure 2).

The Government is virtually the only other source of funds that supports Swedish R&D efforts. In 1973, public revenues furnished more than 42% of such monies, while educational and nonprofit institutions contributed only 1%. In terms of funds usage, government agencies spent about 22%, distributing the balance to the education and industrial sectors.

The number of scientists, engineers, and laboratory technicians engaged in work in the life sciences and laboratory-related physical sciences exceeded 38,000 in 1973 (see table 4). Among scientists, chemists outnumbered physicists by a 3 to 1 ratio. Employers in the government, industrial, and education sectors are experiencing little difficulty in recruiting qualified personnel from among the growing ranks of graduates of Sweden's universities and technical institutes.

Laboratories in the chemicals industry.— The chemicals industry appears to be headed for a period of strong growth following the general decline in demand experienced during the early 1970's. Sales, which totaled $1.6 billion in 1973, are expected to rise by an annual rate of 7% through 1979. The outlook is particularly bright for the pharmaceutical sector, which has successfully stepped up its export efforts. This situation augurs well for sales of laboratory instruments, since drug manufacturers account for half the industry's spending on research and development. Also

Figure 2. **Sweden: R & D expenditures**[1], **1974 and 1979**
(in millions of U.S. dollars)



[1] Represents expenditures on R & D performed in the designated sectors, regardless of the original source of the funds.

Sources: Central Board of Statistics, Swedish Board for Technical Development, and trade source estimates.

likely to draw increased R&D funds are producers of organic chemicals, explosives, and fertilizer. Total expenditures by the chemicals industry for laboratory instruments are expected to climb by a yearly average of 8.5%, reaching $10.5 million in 1979 compared with $7 million in 1974 (see table 5).

Mainly because of projects being undertaken in the petrochemicals field, investment is rising at a much faster rate in the chemicals industry than in most other Swedish industries. Capital expenditures by chemicals firms are forecast to rise by 6% per year during the 1974-79 period, compared with 3.8% for industry as a whole.

Sweden's chemicals manufacturers maintain approximately 200 laboratories. About 150 of these have budgets of less than $50,000 apiece per year, but there are 10 that annually spend more than $200,000 each. Reportedly, 25 laboratories account for 60% of the industry's laboratory instrument purchases.

Approximately 2,000 people are employed in chemicals industry laboratories, including 1,300 who work in the pharmaceutical sector. All but 300 employees are university graduates or have received other specialized training beyond the high school level.

Laboratories operated by the four leading manufacturers of pharmaceutical products—Astra, Kabi, Pharmacia, and Ferrosan—constitute one-fifth of all such facilities in the chemicals industry. Astra is reporting annual sales increases of 20%. In 1973, drugs represented $160 million of Astra's $225 million turnover. Together, the company's four main laboratories (basic research, product development, toxicology, and quality control) employ 450 persons. Laboratory instruments cost Astra approximately $800,000 per year. An initial supply of instruments for a planned addition to the toxicology laboratory will involve instrument purchases of $50,000.

Kabi, with a 1973 turnover of $60 million, has 10 laboratories employing some 125 persons in all. Most of its laboratory work is in applied biochemistry, with particular emphasis on the study of enzymes, especially isoenzymes. The firm is slated to begin a major project that will involve the construction of a completely new research laboratory. Details of this undertaking have yet to be announced.

Pharmacia, whose 1974 turnover is placed at approximately $100 million, maintains 14 laboratories employing a total of 150 persons. Much of Pharmacia's production and research is based on the dextran solutions "Macrodex" and "Rheomacrodex" but the application of nonsoluble expanding polymers is also an important area of study. During the next few years, Pharmacia plans to spend large sums on research and development in diagnostics (allergic and radioimmunological tests) and separation products. The firm's budget calls for two new laboratories to be built in 1976 and 1977, with an estimated $100,000 in new instrumentation to be purchased for each facility.

Table 4.—Sweden: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1973

	Scientists	Engineers	Technicians
Employed by:			
Government	900	1,900	2,200
Industry	3,300	14,000	9,000
Educational and nonprofit institutions	2,300	1,700	2,800

Source: · Data based on statistics provided by the Central Board of Statistics, Scientific Academy of Engineers, and the Swedish Board of Technical Development.

Ferrosan, which reported sales of $45 million in 1973, is planning to boost its production capacity by 40% with construction of a new plant scheduled to be completed by the end of 1976. The facility will include a new laboratory, but most of the additional work generated by the increased production will be carried out in the eight laboratories already in operation. The greater workload will require investments in new laboratory instruments amounting to $75,000 to $100,000.

Two major chemicals industry laboratories outside the pharmaceuticals sector are Kema Nord and Boliden, Chemical Division. Kema Nord's one laboratory, employing 200 persons, is primarily engaged in raw materials analysis and product development. Boliden, primarily a producer of sulfuric acid, has one laboratory that employs 100 persons and handles both R&D and test and evaluation work.

Several projects in the petrochemicals sector should generate significant new demand for laboratory instruments during the 1975-79 period. For example, three Swedish manufacturers of chemicals—Kema Nord, Berol Kemi, and Unifos Kemi—recently set up Stenungsund Kemiska, a joint venture, to build a $180-million cracking plant designed to produce 500,000 tons of ethylene annually. This project, expected to be completed in 1979, will require a $150,000 investment in laboratory instruments. Unifos Kemi is slated to begin construction in 1977 on a $12 million plant that will turn out 50,000 tons of polypropylene per year. Instruments for the plant's laboratory could cost $150,000.

Analytical methods now used in laboratories in Sweden's chemical industry and which will continue or increase in importance during the next few years include the use of HPLC, infrared spectrometry, mass spectrometry, radiometry, differential thermal methods, refractometry, and computer-directed spectrophotometry.

Almost every major laboratory in Sweden's chemicals industry has installed at least one minicomputer. Sales of such equipment are expected to climb rapidly as electronic data processing (EDP) techniques are extended to new areas of application. Purchases made during the next few years will primarily consist of minicom-

Table 5.—Sweden: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	Laboratory expenditures[1]		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	55	$8.5	$17	$7.1	$14
Educational and nonprofit institutions	560	12.7	25	10.6	21
Independent commercial laboratories	15	2.2	4	1.8	4
Medical organizations	670	18.6	39	15.5	33
Industry:					
Oil and gas extraction	20	.8	2	.7	1
Food products	35	2.2	4	1.8	3
Chemicals	200	7.1	11	7.0	11
Petroleum	25	2.8	5	2.3	4
Rubber and plastic products	80	2.6	5	2.3	4
Stone, clay, and glass	5	.6	1	.5	1
Primary metals	120	9.6	12	8.0	10
Fabricated metal products	75	2.8	5	2.3	4
Transportation	25	4.1	8	3.4	7
Other	500	14.3	25	10.8	19
Total	2,385	$88.9	$163	$74.0	$136

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[1] Excludes salaries.

Source: Values based on Swedish trade source estimates.

puters for interfacing with existing instruments, but sales of complete computer-directed systems will rise as present instruments require placement and as new laboratories are built.

Laboratory instruments with especially promising sales prospects in the chemicals industry over the next few years include liquid chromatographs, gas chromatographs, automatic analyzers, thermal analyzers, electron microscopes, and spectrometers.

Laboratories in the primary metals industry.—Sweden's sales of iron, steel, aluminum, copper, and other primary metals exceeded $2.2 billion in 1973 and are expected to rise by an average of 9% per year from 1974 to 1979. Capital expenditures, placed at $204 million in 1973, are not rising as fast in the primary metals sector as in most other sectors of Swedish industry. Outlays are expected to rise by 2% annually during 1974-1979, with the bulk of the investment tied to a single project to be undertaken in 1978 and 1979. However, both laboratory expenditures and laboratory instrument purchases by metals producers are forecast to rise by 4.6% annually from 1974 through 1979. Instrument purchases may reach $10 million at the end of the period.

Ten of the 120 laboratories operated by Swedish producers of primary metals have expenditures of more than $200,000 per year; about 20 spend between $100,000 and $200,000 annually, 30 usually allocate $50,000 to $100,000 to such purposes, and 60 laboratories have budgets of less than $50,000. Approximately 2,400 people are employed in metals industry laboratories. University graduates make up 20% of the staff, while 60% have some technical training beyond secondary school, and 20% have secondary school educations.

All but about 25 of the laboratories in the primary metals sector belong to one of the 60 major manufacturers who employ more than 100 persons. Of these laboratories, 30 account for 60% of the sector's purchases of laboratory instruments. Research and development work commonly centers on corrosion, material resistance, chemistry, metallurgy, techniques for continuous casting, and methods of conserving energy during the production process.

The metals industry has announced a few investment programs that would boost spending for laboratory instruments during the 1975-79 period. The largest, involving an instrument budget that would exceed $1 million, is the Stalverk 80 steelmill, planned by Norrbottens Jarnverk AB (NJA). This proposed steel mill would have a capacity of 4 million tons annually. Described as the largest single capital investment program in the history of Sweden, Stalverk will involve the expenditure of $1.1 billion between 1978 and 1980. In connection with its general expansion program, and in addition to setting up laboratories in the new mill, NJA is to upgrade and enlarge its present central research and analysis laboratory, spending an estimated $200,000 for new instruments.

The Government of Sweden, through the Styrelsen for Teknisk Utveckling (Technical Development Board) is coordinating and providing partial financial support for a joint research project involving 10 companies. The industrial use of hydrometallurgic methods is the subject of this program, which was launched because of the current interest in recycling and conserving raw materials.

Analytical methods commonly employed by laboratories in Sweden's primary metals industry are electron microscopy, electron paramagnetic resonance, magnetic susceptibility, NMR spectrometry, and X-ray methods. The use of EDP technology—chiefly the in-

Table 6.—Sweden Educational and medical laboratory expansion and construction planned for start during the 1975-79 period

(in millions of U.S. dollars)

	Type of project	Cost of laboratory instruments
At educational institutionss:		
Agricultural University, Uppsala	New university	2.0
Lund University, Lund	New schools of geology, geography, and nutrition	2.0
Stockholm University	New schools of chemistry and biology	3.5
Stockholm University	New schools of geology and geography	1.5
Royal Technical University, Stockholm	Renovation of chemistry laboratory	2.0
Umea University	New physics department	.8
At medical facilities:		
Biomedical Center, Uppsala	Entirely new facility	3.0
Regional Hospital, Vastervik	New clinical physiology laboratory	2.0
Regional Hospital, Vaxjo	Expansion of clinical pathology laboratory	1.0
Regional Hospital, Uddevalla	Expansion of clinical chemistry laboratory	1.5
Regional Hospital, Eskilstuna	Expansion of clinical physiology	1.5
Central General Hospital, Norrkoping	Expansion of clinical chemistry, clinical physiology, and clinical pathology laboratories	3.0

Source: U.S. Department of Commerce, Bureau of International Commerce market research survey.

terfacing of minicomputers with existing instruments—is spreading rapidly.

Sector spending for laboratory instruments during the 1975-79 period will for the most part consist of replacement buying. There will be limited purchases of items needed in connection with projects mentioned above. Instruments that should be in particularly strong demand are voltage recorders, circuit testing instruments, fatigue testers, gas analyzers, X-ray and diffraction spectrometers, thickness and resistance measuring devices, magnetometers, electron microscopes, and penetrometers.

Educational and nonprofit research laboratories.—Observers have identified two trends in Swedish higher education that should have a positive effect on laboratory expenditures and purchases of new instruments by the sector during the next few years. First is the policy of university decentralization adopted in 1973. Branches of the universities and technical colleges at Stockholm, Gothenburg, Uppsala, and Lund are being established throughout Sweden, creating a need for new scientific laboratories at each site. Second, the Government wants to promote the study of the physical sciences, which it believes have received less emphasis in the past than the humanities. In this connection, the recognizes the need to replace obsolete equipment in existing laboratories and perhaps enlarge the areas devoted to laboratory work, so that more students can be accommodated.

There are at present some 560 laboratories at Sweden's educational and nonprofit research institutions. Only 20 laboratories have annual expenditures of more than $100,000, and about 450 spend under $10,000 per year.

Approximately 1,400 scientists and 1,800 technicians work at these facilities. Of the scientists, 700 are chemists, 250 are physicists, and 150 are biologists; the remainder pursue other disciplines.

The major educational laboratories are the Biochemical Laboratory at Stockholm University (which specializes in enzymes research), the Laboratory of Physics I at the Chalmers Technical University in Gothenburg (spectroscopic study of molecular structure), and three laboratories at Stockholm's Royal Technical University: the Laboratory of Physical Chemistry (molecular spectroscopy, photochemicals, and low energy electron diffraction study of structures), the Laboratory of Analytical Chemistry (titrimetry, spectrophotometry) and the Laboratory of Electrical Measurement Techniques (computerized methods of measurement).

Several new institutes for the study of the physical sciences are to be constructed at Sweden's leading universities during 1975-1979. Stockholm University plans to spend $5 million on laboratory instruments to equip its new schools of chemistry, biology, geology, and geography (see table 6).

Analytical methods most commonly used at Swedish university laboratories include spectrometry, electrometry, electron microscopy, X-ray methods, chromatography, NMR, and colorimetry. Increasingly, laboratory instruments are being interfaced with minicomputers, especially at the larger laboratories. Heads of laboratories have expressed the hope that within a few years it will become practical to buy complete, computer-directed systems.

Laboratory instruments for which educational sector demand is expected to be particularly strong between 1976 and 1979 are pH meters; chromatographs; spectrometers; spectrophotometers; digital voltmeters; and automatic, spectrum, and thermal analyzers.

Medical laboratories.—Sweden's medical laboratories are experiencing a rapidly expanding demand for their services. Reportedly, this situation has arisen because of the increased emphasis that administrators of the government medical care program are placing on preventive medicine. The recent advances in the speed and reliability of diagnostic tests is also a contributing factor.

In order for these laboratories to perform a significantly greater volume of tests with only a moderate increase in personnel, purchases of both replacement and new instrumentation— especially EDP equipment—will be necessary. Total laboratory expenditures by medical organizations may exceed $39 million in 1979, compared with $18.6 million in 1974.

Sweden has about 670 medical laboratories employing a total of 850 scientists and 2,300 technicians. Approximately 30 laboratories have annual expenditures in excess of $100,000, and 40 spend between $10,000 and $100,000; the great majority, however, report yearly outlays of less than $10,000. Large laboratories, such as those at the Karolinska Hospital and the Huddinge Hospital in Stockholm, the Academic Hospital in Uppsala, and the Central General Hospital in Lund, probably account for 30% of the medical laboratory sector's instrument purchases.

A number of Sweden's medical laboratories are slated for renovation and expansion during the 1975-79 period, and new laboratories will be built at two institutions. All these projects are being funded by the appropriate County Council.

Methods of analysis commonly used in Sweden's medical laboratories include chromatography, spectrometry, electrophoresis, electrometry, electron microscopy, radiometry, and NMR. Computer technology is being widely adapted to laboratory work, especially at Uppsala's Academic Hospital.

Types of laboratory instruments most likely to be purchased by medical laboratories over the latter half of the 70's include conventional microscopes, electron microscopes, spirometers, ergometric and electrometric instrumentation, ultraviolet and visible spectrophotometers, electrophoresis equipment (especially for paper electrophoresis), and advanced types of chromatographs.

Trade and Technical Regulations

Customs duties applicable to laboratory instruments imported into Sweden from the United States range from 5% to 7% of the c.i.f. value of the instrument. Limited quantities of equipment intended for educational or scientific use may be imported free of duty provided that such equipment is not produced in Sweden to any significant extent. Information concerning official Swedish duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

The characteristics of Sweden's electrical power supply are 380/220 volts, 50 hertz, three-phase. The metric system of weights and measures is the statutory standard in Sweden.

Information on the availability of published standards for laboratory instruments in Sweden may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Sweden is available on a continuing basis from:

Country Marketing Manager-Sweden
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce,
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

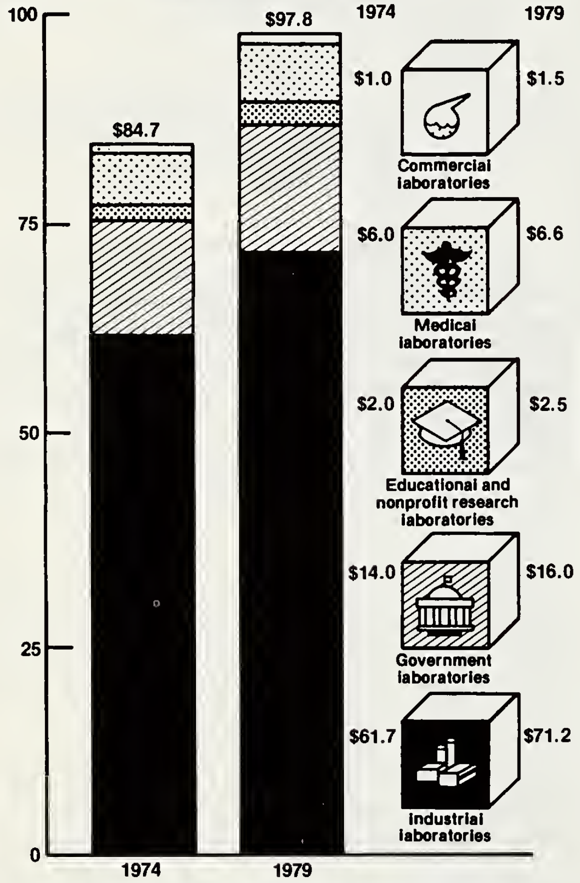
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request "The Market for Laboratory Instruments— Sweden," DIB 75-07-509, January 1975.

United Kingdom

U.S. laboratory instrument manufacturers can expect to enlarge their sales in the United Kingdom during the 1974-79 period. British instrument producers, faced with lower profits and reduced budgets, are presently restricted in their development of new and more sophisticated products. High-technology items will increasingly be supplied by foreign sources and the superiority of American instruments gives U.S. firms a distinct advantage.

Figure 1. **United Kingdom: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)**



Source: Bureau of International Commerce, Office of International Marketing research report; values based on British trade source estimates.

The laboratory instruments market in the United Kingdom grew rapidly in the early 1970's, exceeding $64 million[1] in 1972 (see table 1) and rising another 28% in 1973. Then various economic disruptions led industrial and other laboratories to reduce their capital expenditures and defer nonessential equipment purchases. Laboratory instrument sales grew only 4% in 1974 and dropped by 5%, to an estimated $80 million, in 1975. Any further reductions in equipment would seriously affect laboratory performance and damage the research capabilities of the country. Most end users expect the laboratory instrument market to recover slowly, averaging 5% annual growth between 1975 and 1979, when a $98 million market is forecast (see figure 1).

Industrial laboratories account for nearly three-fourths of the U.K. laboratory instrument market. Sales to industry are projected to increase from nearly $62 million in 1974 to more than $71 million in 1979. Purchases by the chemical industry, the largest user sector, are expected to grow nearly twice as fast as the overall industrial market, reaching $22.5 million in 1979.

Government laboratories are the leading nonindustrial users of instruments; they bought equipment, primarily for research associated with defense and atomic energy, valued at $14 million in 1974. Government laboratories are projected to spend $16 million on instruments in 1979, accounting for over 16% of the market.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates: U.S. $1.00 = .400 pounds (1972); .408 pounds (1973); .417 pounds (1974 and subsequent years).

Table 1.—United Kingdom: Size of market for laboratory instruments, 1972, 1974, and 1975

(in millions of U.S. dollars)

	1972	1974	1975
Production	90.9	117.6	115
Imports	28.3	48.4	48
Exports	55.1	81.3	83
Market size[1]	64.1	84.7	80

[1] Market size equals production plus imports minus exports.

Source: Values based on British trade source estimates.

Medical laboratories spent $6 million for instruments in 1974 and are projected to invest $6.6 million in 1979. Independent commercial laboratories account for only a small percentage of the laboratory instrument market but are expected to increase their purchases faster than any other end-user group during the 1974-79 period.

Competitive Environment

U.K. manufacturers design and produce excellent laboratory instruments, which are sold throughout the world. However, the range in types of domestic equipment is limited and must be supplemented by foreign goods. Imports of laboratory instruments increased an average of 31% annually between 1972 and 1974, growing from more than $28 million to over $48 million. Despite the overall decline in the market, imports held steady in 1975 and are expected to continue rising by an average 7% annually through 1979. The share of the market supplied by imports is also rising steadily—from 44% in 1972 to 57% in 1974 and a projected 65% in 1979.

U.S. firms are the principal suppliers of imported laboratory instruments (see table 2). Imports from the United States jumped from almost $11 million in 1972 to $22 million in 1974, a 43% average annual growth. U.S. sales are forecast to increase an average 7.6% yearly until 1979 when American manufacturers are expected to export laboratory instruments valued at almost $32 million. U.S. firms are holding ever-larger shares of the import market: over 38% in 1972, nearly 46% in 1974, and 50% projected in 1979.

In addition to importing directly from the United States, several American firms also sell through plants operating in the United Kingdom and/or other foreign countries. U.S. companies have achieved their prominence through the superior performance and reliability of their products. U.K. buyers praise the versatility, sensitivity, and accuracy of American-designed instruments. The market and support activities of the larger U.S. manufacturers rank among the best in the United Kingdom; servicing capabilities are considered good,and personnel training facilities are above average.

Perkin-Elmer Corp. is one of the major U.S. suppliers in the U.K. market. The firm sells spectrophotometers in the United Kingdom, leads the market for gas chromatographs, and has made substantial gains in sales of spectrometers and other laboratory instruments.

The Analytical Division of Hewlett-Packard markets chromatographs, mass spectrometers, oscilloscopes, and other analytical instruments. Beckman Instruments also sells a wide range of instruments but is best known in the United Kingdom for infrared (IR) spectrophotometers and centrifuges. Materials-testing equipment is sold by Instron Corporation. Optical emission and X-ray fluorescence (XRF) spectrometers are the major products sold by Applied Research Laboratories, a Bausch & Lomb subsidiary with factories in the United Kingdom and Switzerland.

Varian Associates is currently the largest supplier of nuclear magnetic resonance (NMR) spectrometers to the United Kingdom. The company also sells a large portion of the atomic absorption (AA) spectrophotometers and smaller shares of the gas chromatograph and mass spectrometer market. The Finnigan Corp. and E. I. du Pont de Nemours & Co., Inc. are well known in the United Kingdom for liquid chromatographs and mass spectrometers; du Pont has also made inroads into the thermal analyzer market. Technicon Co. is the major supplier of automatic chemical analyzers used primarily in medical laboratories. The company supplies most of its U.K. customers from its assembly plant in Ireland. Tektronix Inc. sells high-performance oscilloscopes, and Corning Glass Works is the leading supplier of imported laboratory pH meters.

Domestic production of laboratory instruments has followed the general pattern of the market—output rose an average of nearly 14% annually between 1972 and 1974, totaling almost $118 million in the latter year, then declined 2% in 1975; a 4% average annual growth rate is predicted through 1979. Foreign-owned firms, primarily American, account for about 40% of production. Several hundred U.K. firms manufacture laboratory instruments, and 10 of these companies account for 50% of the industry's sales. The major manufacturers are Scientific and Medical Instruments, makers of electron microscopes, X-ray microanalyzers, and microwave spectrometers; AEI Scientific Apparatus, producers of mass spectrometers and electron microscopes; Rank Precision Industries, best known for spectrochemical analyzers; L Oertling, principally a supplier of precision balances; VG Instruments, whose major product is mass spectrometers; and S. Brannan and Sons, a leading manufacturer of thermometers.

Domestic manufacturers have a considerable competitive advantage in selling equipment to government departments, nationalized industries, hospitals, and educational establishments. These end users are expected to buy from British sources whenever possible and must justify in detail any purchases of foreign equipment.

U.K. manufacturers excel in some product areas, particularly electron microscopes and mass spectrometers, and have built extensive export markets. Foreign sales have grown steadily during the 1970's, rising from over $55 million in 1972 to more than $81 million in 1974, an average annual increase of 22%. By 1979, instrument manufacturers expect to sell 75% of their production overseas. Continued growth of exports depends on the technical standards achieved by U.K. manufacturers, their production costs, and the sterling exchange rate. Thus far, increases in costs have been balanced by deterioration in the exchange rate, and over a $100 million export market in 1979 seems a realistic forecast.

Third-country suppliers to the U.K. market are led by Philips of the Netherlands and its British subsidiary, Pye Unicam. XRF equipment and electronic instruments such as oscilloscopes are imported from the parent firm, while chromatographs, spectrophotometers, and pH meters are manufactured locally.

Germany ranks second to the United States as a source of imported laboratory instruments for the United Kingdom, but a large portion of these goods comes from subsidiaries of U.S. firms. The leading German suppliers include Bruker (NMR spectrometers), Sauter (precision balances), and Siemens (X-ray spectrometers and electron microscopes). JEOL, a Japanese manufacturer, has successfully sold mass spectrometers and electron microscopes to U.K. end users. The Swedish firm, LKB Produkter, is an important supplier of chromatographs, and Radiometer of Denmark provides pH meters. All of these companies depend on technology rather than price to sell their products.

Swiss firms are noted in the United Kingdom for their well-made precision balances. Mettler, a leading Swiss supplier of top-loading analytical balances, has developed a substantial British market on the basis of superior technology. Electronic Instruments, a U.K. subsidiary of another Swiss firm, chiefly manufactures pH meters.

Selected instrument markets.— The Office of International Marketing, Bureau of International Commerce, selected 15 instruments as market indicators (see table 3) and reviewed their sales prospects for the 5 years between 1974 and 1979. According to this survey, U.K. purchases of *gas chromatographs* should increase from $6 million to $6.7 million in that period. These instruments are already widely used and their suppliers well established; therefore, no change in the market balance is foreseen.

On the other hand, innovations in *liquid chromatographs* are expected to boost sales by an average of 12% annually between 1974 and 1979 and raise the U.S. share of the market from 30% to 40%. Developments in high-pressure liquid chromatography are particularly attractive to British users.

The *mass spectrometer* market is expected to rise about 6% annually from 1974 to 1979. Low-priced instruments will be in greatest demand, and the unit price of high-resolution mass spectrometers is expected to fall. Imports from U.S. firms and their foreign subsidiaries are expected to increase, taking sales from domestic manufacturers who are less able to modify and diversify their products.

Laboratories in the United Kingdom are cutting down on basic research and concentrating more on applied research and quality control. This trend will reduce the growth of *NMR spectrometer* sales to about 1.6% annually. U.S. firms will remain the market leaders, but increasing competition is expected from German and Japanese companies.

Demand for *pH meters* closely parallels the increase in total laboratory expenditures between 1974 and

Table 2.—United Kingdom: Imports of selected laboratory instruments, 1972-1974

(in thousands of U.S. dollars)

	1972	1973	1974
Electrical instruments for physical or chemical analysis:			
United States	3,079	5,446	5,507
Germany	1,075	1,105	1,567
Switzerland	417	680	680
Austria	29	573	16
Other	1,907	2,546	3,541
Total	6,507	10,350	11,311
Photoelectric spectrophotometers containing optical elements:			
United States	751	922	2,064
Germany	218	167	243
Netherlands	176	328	125
Switzerland	26	352	102
Other	374	428	813
Total	1,545	2,197	3,347
Electrical machines for testing hardness, strength, compressibility, and elasticity, of industrial materials:			
United States	483	673	1,068
Austrlia	38	370	337
Germany	132	302	166
Switzerland	53	136	105
Other	210	255	300
Total	916	1,736	1,976
Electrical instruments for measuring or checking viscosity, porosity, expansion, surface tension, etc.:			
United States	193	452	503
Germany	94	81	188
Switzerland	78	162	147
Netherlands	32	65	84
Other	175	237	225
Total	572	997	1,147

Source: Based on data supplied by the H.M. Customs & Excise, Statistical Office, and British trade source estimates.

Table 3.—United Kingdom: Sales of selected laboratory instruments, by origin estimated 1974 and projected 1979

(in millions of U.S. dollars)

	1974				1979			
	Total	*United States*	*Other foreign*	*Domestic*	*Total*	*United States*	*Other foreign*	*Domestic*
Gas chromatographs	6.00	1.50	.60	3.90	6.70	1.70	.65	4.35
Liquid chromatographs	2.00	.60	.30	1.10	3.50	1.40	.50	1.60
Mass spectrometers	3.00	.90	.30	1.80	4.00	1.60	.80	1.60
NMR spectrometers	2.40	1.70	.50	.20	2.60	1.55	.80	.25
pH meters	2.00	.40	.20	1.40	2.30	.45	.35	1.50
Densitometers	.30	.10	.05	.15	.30	.10	.05	.15
Thermal analyzers	.30	.05	.10	.15	.30	.10	.10	.10
Automatic analyzers	6.90	1.70	3.80	1.40	7.50	2.25	3.35	1.90
Electron microscopes	7.20	.35	3.60	3.25	6.90	.35	3.80	2.75
X-ray analyzer equipment	3.80	.40	2.30	1.10	4.10	.90	2.20	1.30
Balances	6.40	.45	3.75	2.20	7.30	1.10	3.65	2.55
Oxygen analyzers	.20	.05	.05	.10	.20	.05	.05	.10
AA spectrophotometers	3.20	.95	.65	1.60	4.50	1.80	.90	1.80
IR spectrophotometers	2.80	.55	.85	1.40	3.00	.75	.90	1.35
Oscilloscopes	4.00	1.20	.50	2.30	4.60	1.40	.70	2.50

Source: Values based on British trade source estimates.

1979, which is forecast to rise by an average of nearly 3% yearly. About 70% of the pH meters were supplied by domestic producers in 1974, but imports from Europe are expected to reduce that percentage slightly by 1979. U.S. manufacturers, who are price competitive in the more sophisticated pH meters should retain 20% of sales.

The ***densitometer*** market is expected to remain around $300,000 a year throughout the 5-year period. Increased usage in some applications will be balanced by a decline in their use in conjunction with analytic equipment. U.K. producers supplied 50% of these instruments in 1974, and most of the remainder was imported from the United States. Joyce, Loebl is a leading U.K. producer. A slight shift in favor of U.S. companies is predicted, in line with general market trends.

Thermal analyzers are being replaced by other types of instruments, and no market growth is forecast. Only a modest increase in purchases of ***automatic chemical analyzers*** is expected—sales to medical laboratories have passed their peak in the United Kingdom, and further growth in the market must come from industrial users.

Two factors will contribute to a 1% annual decline in the ***electron microscope*** market. Initial purchases to enhance laboratory facilities will have diminished by 1979, and basic research, the primary user of electron microscopy, will suffer more severely from laboratory expenditure readjustments than will other activities. U.K. manufacturers supplied 45% of the market in 1974, while third-country firms provided 50%. Prices and specifications of imported products are steadily becoming more attractive compared with domestic products, and Dutch and Japanese firms are expected to increase their market penetration. Annual sales of U.S.-made electron microscopes are not expected to change.

The market for ***X-ray analyzer equipment***, including dispersive and nondispersive XRF spectroscopy and X-ray diffraction instruments, is projected to grow by 3% annually, reaching $4.4 million in 1979. Technological developments, particularly increased sensitivity, in U.S. products of this type are expected to raise the U.S. share of the market from 10% to 20% at the expense of German and Dutch firms.

Total sales of ***balances*** are forecast to rise from $6.4 million in 1974 to $7.3 million in 1979. Above-average growth is predicted for purchases of electronic balances, including those with remote reading facilities. U.K. production supplied about one-third of the market in 1974, and third-country firms provided 58%.

Oxygen analyzers are rarely used in U.K. laboratories; oxygen content is usually determined by gas analyzers capable of a wider range of measurements. Sales are expected to remain constant at $200,000 per year, with over half the market supplied by U.K. companies.

Following introduction of stable lamp sources, ***AA spectrophotometers*** emerged as the subcategory showing fastest growing sales in the field of spectrometry, taking much of the growth potential from other spectrophotometers. In the 1974-79 period, an average annual growth rate of more than 7% is forecast for these devices. U.S. firms and their foreign subsidiaries are expected to capture ever-larger percentages of the market, reducing sales by British manufacturers. New high performance equipment is more likely to be developed in the United States, and the rapid growth of the market should encourage more American companies to promote their products in Britain.

Growth of the ***IR spectrophotometer*** market is expected to be slightly below average because of the relatively large proportion of these instruments used for basic research. Low and medium-priced instruments have the best sales prospects. U.S. firms are expected to improve their market position by 1979 as the competitive standing of German suppliers is affected by revaluation of the Deutsche mark.

Sales of *oscilloscopes*, $4 million in 1974, are expected to grow an average 2.8% annually and to reach $4.6 million in 1979. End users will be looking for higher performance and lower unit prices. U.S. firms and their subsidiaries are major suppliers, and little change in the origin of instruments is expected.

Major Purchasers

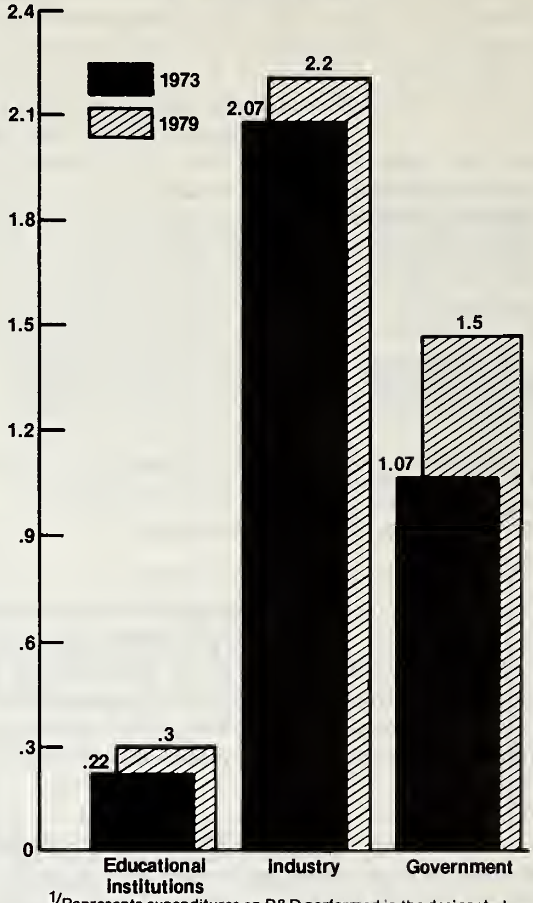
Total R&D expenditures in the United Kingdom are expected to increase an average 3% annually between fiscal year (FY) 1973[2] and 1979, but shifting priorities will lead to higher growth rates in some fields. Budgets for research on agriculture, medicine, the natural environment, and the social sciences are scheduled to increase 3.5% annually. Expenditures for energy research, particularly studies of nuclear power generation, will also rise at an above-average rate. Defense, despite a decline in funding, will draw the largest share of government R&D monies through 1980. Industry-funded R&D is primarily allocated for chemicals and electrical engineering. The fastest growth is expected in the pharmaceutical and petrochemical sectors, followed by the electronics (including computers) and telecommunications sectors.

The Government provided nearly 58% of the $3.4 million spent for R&D in the United Kingdom in FY 1973. This share will decline to about 55% by 1979 as the Government reduces its support of industrial research. The principal user of R&D funds in FY 1973 was industry, including nationalized industries and public corporations, which accounted for 62% of the expenditures (see figure 2). Industry is expected to increase its funding by more than 4% annually, supplying nearly 45% of the $4 million to be used for R&D in 1979. Educational institutions provide less than 1% of the research funds; they are expected to increase their expenditures by nearly 5.3% annually between FY 1973 and 1979. About 28% of R&D funds is ultimately spent for laboratory equipment.

U.K. laboratories employed some 78,500 scientists, engineers, and technicians in the life sciences in 1974 (see table 4). More than 99% were trained in the United Kingdom.

Laboratories in the chemical industry.—The U.K. chemical industry spent $17 million for laboratory instruments in 1974, accounting for 20% of the market (see table 5). The industry's heavy reliance on R&D and quality control is expected to sustain an average annual increase in instrument purchases of nearly 5.8%, well above the growth rate predicted for most other market sectors in the 1974-79 period. The 20 largest laboratories buy 70% of the industry's instruments.

Figure 2. United Kingdom: R&D expenditures,[1] FY 1973 and 1979 (in billions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors, regardless of the original source of the funds.

Source: Values based on British trade source estimates.

In early 1975, industry spokesmen announced a $3.7 billion investment plan designed to increase output by 5.5% annually between 1975 and 1980. Sales are expected to advance from $7.8 billion in 1974 to $10 billion in 1979, while capital investment expands from $936 million to $1.1 billion. The greatest increases in R&D budgets are anticipated for laboratories working with pharmaceuticals, agrochemicals, and petrochemicals, particularly synthetic resins and plastics. Developing and testing of these products require a high degree of innovation and the use of sensitive analytical equipment. Toxicological testing has also gained importance in recent years.

The chemical industry employs a wide variety of analytical methods. About half of the large laboratories use electrometric and X-ray methods, and a smaller number have instruments for electron paramagnetic resonance, electrophoresis, and saccharimetry. One or two laboratories have added electrography and magnetic susceptibility capacity. NMR and mass spectrometers have routinely been used with computers. Decreasing computer costs have encouraged

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[2] April 1, 1972 to March 31, 1973.

Table 4.—United Kingdom: Persons employed as scientists, engineers, and technicians in the physical and life sciences,[1] 1974

		Scientists	*Other*		*Tech-*
	Physics	*chemistry*	*life*	*Engineers*	*nicians*
Employed by:					
Government	1,800	2,300	2,000	1,500	9,000
Industry	3,500	9,700	1,500	3,500	22,000
Educational and other nonprofit institutions	1,200	2,000	1,500	1,000	4,000

Does not include 12,000 scientists and technicians employed in medical laboratories.
Source: Civil Service Commission, Department of Trade and Industry and British trade source estimates.

users to link other instruments with minicomputers, and the trend now is to purchase complete instrument-computer systems rather than to interface new minicomputers with existing equipment. Chemical industry laboratories are particularly interested in using minicomputers in conjunction with gas chromatographs.

Users in this sector expect to purchase laboratory instruments with higher sensitivity and accuracy than their present equipment, but they are not prepared to adopt fundamentally different analytical techniques. The following instruments offer the best sales opportunities over the 1975-79 period.

- Absorptiometers
- Air-sampling analysis equipment
- Ammeters
- Apparatus for testing physical properties of industrial materials
- Laboratory balances
- Calorimeters
- Laboratory centrifuges
- Gas chromatographs
- Liquid chromatographs
- Galvanometers
- Hydrometers
- Hygrometers
- IR detectors
- Manometers
- Mass spectrometers
- Microchemical analysis apparatus
- Micrometers
- Electron and proton microscopes
- Compound optical microscopes
- Ohmmeters
- Oscilloscopes
- Ozone meters
- pH meters
- Potentiometers
- Scintillation counters
- Spectrophotometers
- Spectrometers
- Stereomicroscopes
- Thermometers
- Viscometers

Laboratories in the food products industry.—Net output of the United Kingdom's food, drink and tobacco industry is forecast to exceed the 1974 total of $10.5 billion by nearly 10% in 1979. Capital investments are expected to grow at a faster rate—close to 17%—raising outlays from $1.2 billion in 1974 to $1.4billion in 1979. The food products industry, which generally allocates about 2.5% of capital expenditures for its laboratories, spent $4 million for instruments in 1974. While nearly all of the 2,450 manufactures in the industry have some facilites for testing or quality control, only 80 establishments qualify as completes laboratories. The 10 classified as large laboratories account for about 45% of the instrument purchases.

Several areas will increase their R&D budgets during the next few years. Tobacco processors anticipate greater expenditures for analysis, health research, and the development of tobacco substitutes. New blends of fats and oils are being sought in response to rapid price changes. Several laboratories are engaged in developing improved flavors and substitute foods such as texturized vegetable protein. Other groups are studying packaging materials and methods.

Nearly all the large laboratories in the food products industry use chromatography, colorimetry, electrophoresis, and spectrometry. About half the laboratories employ electron microscopy, particle size analysis, and turbidimetry and nephelometry, while fewer than 10% apply electrography, electrometry, electron paramagnetic resonance, magnetic susceptibility, and X-ray methods. The tobacco sector makes extensive use of computers in conjunction with laboratory instruments, but high prices and lack of appropriate systems are slowing industrywide adoption of instrument-minicomputer combinations.

Between 1975 and 1979, the food products industry will be buying those laboratory instruments necessary to maintain standards of safety and quality, especially the following:

- Absorptiometers
- Air sampling and analysis equipment
- Ammeters
- Analyzers
- Balances
- Centrifuges
- Gas chromatographs
- Colorimeters

- Galvanometers
- Manometers
- Micrometers
- Compound optical microscopes
- pH meters
- Potentiometers
- Polarimeters
- Refractometers
- Spectrofluorometers
- Spectrophotometers
- Spectrometers
- Thermometers
- Viscometers

Laboratories in the transportation equipment industry.—The industry encompasses manufacturers of ships, tractors, motor vehicles, railway equipment, and aerospace products. Industry sales totaled $15 billion in 1974 and are predicted to advanced by an average 2.5% annually to $17 billion in 1979. Trade sources foresee a rise in capital investments, from $700 million in 1974 to $900 million in 1979, but a decline in laboratory expenditures from $290 million to $170 million during that period. R&D budgets will drop with completion of the development program for the Anglo-French supersonic aircraft, Concorde, and cutbacks in government expenditures for defense projects. Even so, the transportation industry will remain a major consumer of laboratory instruments throughout the 1974-79 period, spending between $3.5 million and $4.5 million annually. The motor vehicle manufacturing sector will probably increase its instrument purchases, especially for laboratories working on pollution control systems.

Eight of the 40 laboratories in the industry account for 80% of the instruments purchased. Transportation equipment manufacturers are primarily concerned with electrical measurement; measurements of force, stress, strain, and other characteristics such as tensile strength; flow measurement and gas analysis. Spectrometry is the most commonly used analytic method; a few laboratories have adopted X-ray methods, turbidimetry and nephelometry, and electron microscopy. Computers are employed extensively. Because of the specialized equipment used in the industry, minicomputers are typically interfaced with existing instruments. Transportation industry laboratories are predicted to invest most heavily in the following instruments during the next 5 years.

- Accelerometers
- Ammeters
- Analyzers
- Anemometers
- Apparatus for testing physical properties of industrial materials
- Capacitance measuring equipment
- Galvanometers
- IR detectors
- Ohmmeters
- Oscilloscopes
- Potentiometers
- Spectrophotometers
- Spectrometers
- Voltmeters

Government laboratories.—The U.K. Government operates about 150 laboratories, most of them specializing in research areas not generally addressed by private

Table 5.—United Kingdom: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in millions of U.S. dollars)

	Number of laboratories	*Laboratory expenditures*		*Purchases of laboratory instruments*	
		1974	1979	1974	1979
Government	150	$300	$350	$14.0	$16.0
Educational organizations	250	30	35	2.0	2.5
Independent commercial laboratories	20	10	15	1.0	1.5
Medical organizations	800	60	70	6.0	6.6
Industry:					
Oil and gas extraction	10	3	4	1.5	2.0
Food products	80	30	34	4.0	1.5
Chemicals	150	90	120	17.0	22.5
Petroleum	20	10	11	2.0	2.4
Rubber and plastic products	40	11	11	2.5	2.7
Stone, clay, and glass	20	9	9	.5	.7
Primary metals	20	22	25	3.2	3.4
Transportation equipment	40	290	170	4.5	3.5
Other	450	350	386	26.5	29.5
Total	2050	$1,215	$1,240	$84.7	$97.8

Source: *Trade & Industry*, 5 September 1974 and British trade source estimates.

organizations. The 10 large laboratories account for 35% of the government's laboratory instrument purchases; half of these facilities are under the jurisdiction of the Ministry of Defense. Some of the Defense Ministry's more important R&D activities are in the fields of naval engineering and weapons, radar and communication systems, atomic weapons, explosives, chemical defense, and aerospace.

The Department of Energy conducts basic scientific research through the United Kingdom Atomic Energy Authority. This major laboratory increasingly engages in R&D in fields important to nonnuclear industries.

The Department of Industry operates three multidisciplinary facilities: the National Physical Laboratory, the National Engineering Laboratory, and the Warren Spring Laboratory. The latter investigates control engineering, materials handling, catalysis, and mineral science and technology.

In addition, the government-supported Industrial Research Associations serve medium- or low-technology industries and are often the technological leaders in the industries they represent. The 34 Associations have a total annual income of about $45 million.

Many research laboratories also carry out test and evaluation functions. For example, the Aeroplane and Armament Experimental Establishment also evaluates aircraft and related systems. The laboratories of the Energy and Industry Departments also offer test and evaluation services in their own specialties.

The Laboratory of the Government Chemist, the principal government test and evaluation laboratory, provides analytical, investigatory, and technical advisory services to all central government departments and has the statutory function of official analyst. The laboratory has a special responsibility to HM Customs and Excise and directs about 35% of its efforts to that Department. The Ministry of Agriculture, Fisheries, and, the Department of Health and Social Security, and the Department of the Environment maintain laboratories for testing food, drugs, and pesticides; for environmental testing; and for evaluating the safety of materials.

Above-average growth in laboratory expenditures is predicted for government organizations that are concerned with energy, the environment, and agriculture and food. The Laboratory of the Government Chemist will probably buy more instruments when it makes its expected move to a new location.

Nearly all analytical methods are used in the highly diversified group of laboratories under government control. The most important techniques include chromatography, electron microscopy, mass spectrometry, NMR spectrometry, and X-ray analysis. Computers are widely used, and the large laboratories are well equipped with both dedicated and centralized computers. Virtually all types of laboratory instruments will be in demand over the next 5 years. Based on the fastest growing areas of research and test and evaluation, the greatest demand is forecast for the following instruments.

Absorptiometers
Air sampling and analysis equipment
Analyzers
Apparatus for testing physical properties of materials
Balances
Barometers
Calorimeters
Centrifuges
Gas chromatographs
Liquid chromatographs
Dosimeters
Hydrometers
Hygrometers
IR detectors
Manometers
Mass spectrometers
Measurement of electrical variables
Spectrophotometers
Spectroscopes
Spectrometers
Tensiometers
Thermometers
Viscometers
X-ray diffractometers

Medical laboratories.—Most medical laboratories in the United Kingdom are supported by the central Government, either directly through the Department of Health and Social Security or indirectly through the Medical Research Council (MRC) or grants to universities and colloges. Some funds ($35 million in 1972) are provided by medical charities. Laboratory expenditures are expected to rise from $60 million in 1974 to $70 million in 1979, with nearly 10% spent for instruments.

The country has 800 medical laboratories; the 25 largest facilities are organized under the Clinical Research Centre, the Institute of Cancer Research, the MRC Research Units, the National Institute for Medical Research (NIMR), and the 16 major teaching hospitals in London and the provinces. These laboratories account for about 30% of the sector's instrument purchases. About 2,000 scientists (or medically trained personnel), 4,000 qualified technicians, and 6,000 student or junior technicians are employed by the sector.

Future growth in sales of laboratory instrument is closely tied to hospital construction. Five or six new hospitals should be built over the next 5 years, adding about $750,000 to the laboratory instrument market. The NIMR recently has scheduled renovations costing $2.5 million. Expenditures are expected to grow fastest for laboratories studying heart and rheumatic diseases and cancer.

Medical laboratories use a fairly restricted range of analytical techniques. Large laboratories rely on chromatography, electrometric methods, electrophoresis, particle size analysis, radiometry, spectrometry, turbidimetry and nephelometry.

Electron microscopy and NMR are used in only the largest laboratories such as the NIMR.

The introduction of the automatic chemical analyzer had tremendous impact on the sector; now that most clinical laboratories have been equipped with these systems, demand may slip, but the replacement market is expected to increase. Some analytical instrumentation is linked to computers.

The following laboratory instruments are expected to be in demand in the medical sector during the 1974-79 period.

Absorptiometers
Analyzers
Balances
Centrifuges
Gas and liquid chromatographs
Colorimeters
Microdensitometers
Compound optical microscopes
Osmometers
pH meters
Potentiometers
Spectrofluorometers
Spectrophotometers
Thermometers
Viscometers

Educational organizations.—Each university in the United Kingdom maintains several laboratories, usually one for each scientific discipline, adding up to a nationwide total of 250 such research establishments. About 14,000 full-time faculty members are engaged in scientific, engineering, and technological studies. Space, metallurgy and materials, chemistry, nuclear physics, biological science, astronomy, and physics are the major areas of research.

Educational laboratories are supported by the Government, through such bodies as the Science Research Council and the University Grants Committee. Some research is sponsored by industries or philanthropic foundations. Laboratory expenditures are predicted to grow from $30 million in 1974 to $35 million in 1979; instrument purchases are expected to rise from $2 million to $2.5 million. Seven universities—London, Cambridge, Oxford, Manchester, Edinburgh, Birmingham, and Liverpool—account for 45% of the sector's instrument purchases.

The diversity of research projects creates demands for all major analytical methods in educational laboratories. The principal methods of chemical analysis used in the large laboratories are chromatography, electron microscopy, magnetic susceptibility, mass spectrometry, NMR, and radiometric, spectrometric, thermal, and X-ray methods. Computers are used primarily for NMR and mass spectrometers, where the results cannot reasonably be analyzed by any other means.

Universities deliberately purchase a wide variety of instruments to help familiarize students with the types of equipment used outside the academic environment and to give faculty members access to the broad range of modern instrumentation important for basic research. Nearly all types of instruments will be purchased during the 1974-79 period, but the largest sales are expected for the following products.

Absorptiometers
Analyzers
Apparatus for testing physical properties of
  industrial materials
Balances
Centrifuges
Gas and liquid chromatographs
IR detectors
Manometers
Mass spectrometers
Instruments for measurement of electronic variables
Electron and optical microscopes
pH meters
Refractometers
Scintillation counters
Spectrometers
Thermometers
Viscometers

Independent commercial laboratories.—The United Kingdom has 20 independent commercial laboratories employing 450 scientists, 200 engineers, and 650 technicians. These laboratories spent $10 million for equipment, including $1 million for instruments, in 1974. Though small, this sector looks forward to an 8.5% average annual growth in laboratory expenditures between 1974 and 1979. Industry is expected to turn to independent laboratories for help in handling their increased needs, particularly in pharmacology, toxicology, and applied biology. In other cases, companies are expected to use commercial concerns rather than maintain underutilized equipment.

The four largest commercial laboratories account for approximately 40% of the sector's laboratory instrument purchases. The Huntingdon Research Centre is concerned with pharmacology, toxicology, and applied biology. Mechanical and electrical engineering, and materials physics are the domain of the International Research and Development Company. Robertson Research International specializes in geology, mining, and petroleum exploration, while the Fulmer Organization deals with physics, metallurgy, physical chemistry, polymer chemistry, plastics, and films.

Since independent laboratories maintain facilities for all types of research, they use all the principal analytic methods. Chromatography, electron microscopy, mass spectrometry, and NMR spectrometry are the major techniques used by large laboratories. Computers are not widely used because of the limited capital resources generally available Between 1975 and 1979, demand will be greatest for the following instruments.

Absorptiometers
Analyzers
Apparatus for testing physical properties of materials
Balances
Centrifuges
Gas and liquid chromatographs

IR detectors
Instruments for measurement of electrical variables
Optical microscopes
pH meters
Spectrophotometers
Spectrometers
Thermometers

Trade and Technical Regulations

The import duty rates for laboratory instruments range from 7% to 19%. Products from other Commonwealth and European countries are taxed at slightly lower rates. Items for scientific research may be admitted duty-free if no suitable equipment is available from a U.K. supplier. A value-added tax, currently 8%, is applied to instruments sold in the United Kingdom. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

British Standards are defined for some instruments used in laboratories, and a new one, covering laboratory instruments in general, is in preparation. There is no legal requirement to conform to these criteria, nor do the majority of end users specify that equipment should follow British Standards. Information on the availability of published standards for laboratory instruments in the United Kingdom may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

U.S. standards for laboratory equipment are generally accepted in the United Kingdom with two exceptions: color coding of electrical supply leads, which should adhere to British practice; and power supply, which is 240 volts, 50 hertz in the United Kingdom.

Safety standards in laboratories are expected to rise following the introduction of the Health and Safety at Work Act. This act, which came into effect in April 1975, places the responsibility for health and safety on the employer, whereas previous acts merely stipulated the series of safety measures deemed necessary.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on the United Kingdom is available on a continuing basis from:

Country Marketing Manager-United Kingdom
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

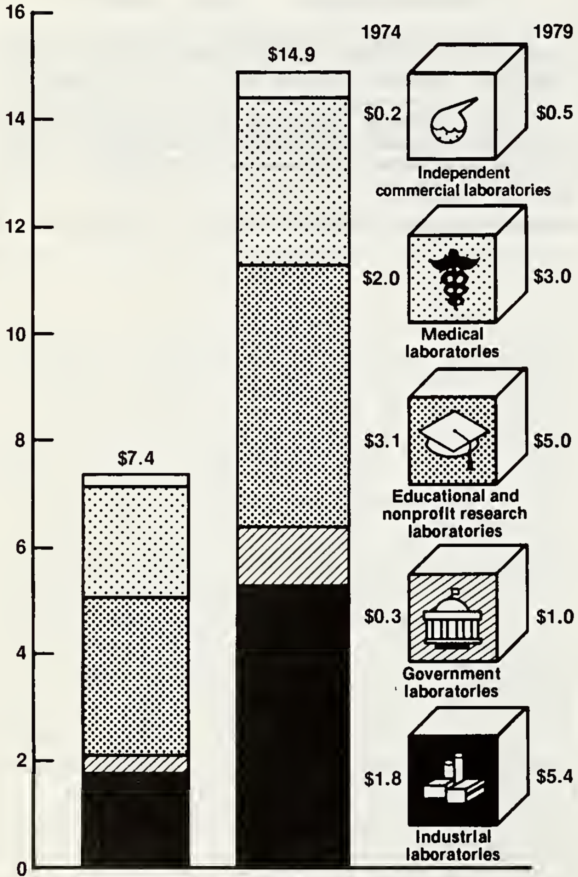
National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments—United Kingdom," DIB 75-08-506, May 1975.

Venezuela

The market for laboratory instruments in Venezuela, although modest, is steadily growing. Sales, which totaled $7.4 million[1] in 1974, are expected to double by 1979. Significant local production of instruments is not expected in the foreseeable future; thus, imports—provided largely by United States firms—will probably continue to supply the entire growing demand. This market grew at an annual rate of over 13% from 1972 to 1974, with sales rising from $5.8 million and is expected to reach $8.5 million in 1975 (see table 1). From 1975 to 1979, expansion is anticipated to average 15% annually. This healthy growth is chiefly attributable to the Government's participation, both directly through financial support, in the rapid development of major industries and educational and medical sectors.

Figure 1. **Venezuela: The market for laboratory instruments 1974 and projected 1979 (in millions of U.S. dollars)**



Source: Bureau of International Commerce, Office of International Marketing research report; values based on Venezuelan trade source estimates.

Educational and nonprofit research institutions are the major users of laboratory instruments. With ample government funds directed toward increasing emphasis on development of the sciences, these organizations are expected to step up laboratory purchases from just over $3 million in 1974 to $5 million in 1979 (see figure 1). Medical laboratories are the second largest users of instruments; as a result of government emphasis on public health and welfare programs, their purchases are forecast to increase from $2 million in 1974 to $3 million in 1979.

Some of the fastest growth will probably take place in industrial laboratories, whose instrument purchases are estimated to rise from $1.8 million in 1974 to $5.4 million in 1979. The anticipated jump in demand will reflect increased use of research facilities by the petroleum industry, following completion of the nationalization process in 1975, and progression by other industrial laboratories from very basic analysis to more varied activities. With few exceptions local industry has relied on overseas firms for basic research and development (R&D). Consequently, advanced laboratory operations in the industrial sector have been slow in developing.

In addition to expanding their own laboratory operations, industries are expected to depend more heavily

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[1] All values are shown in U.S. dollars. Local currency exchange data are converted at the following rates: U.S. $1.00 = 4.40 bolivars (1972); 4.32 bolivars (1973); and 4.26 bolivars (1974 and subsequent years).

Table 1.—Venezuela: Imports and imports from the United States

(in millions of U.S. dollars)

	1972	1973	1975
Total imports	5.76	7.40	8.50
Imports from the United States	3.75	4.81	6.00

Sources: Direccion General de Estadistica y Censos Nacionales, Ministerio de Fomento (Ministry of Development) and trade source estimates.

on independent commercial facilities, which are estimated to more than double in size over the next 5 years. Commercial facilities are likely to increase their use of more sophisticated instruments to service industrial firms that might be reluctant to invest in such instrumentation on their own.

Competitive Environment

United States firms dominate almost all categories of the laboratory instrument market in Venezuela. The U.S. share of the market from 1972 to 1974 approximated 65%, and world currency exchange rate realignments have since made U.S. products more competitive. American firms are expected to increase their market share to 70% in 1975 and to maintain that level throughout the remainder of the 1970's. Venezuela now purchases some standard laboratory instruments from European suppliers, particularly those made in Germany and France, as well as Japan. Highly sophisticated products offer the best opportunities for sales. Service has become an increasingly important factor in purchases, along with product performance and price.

Most industries in Venezuela have strong ties to U.S. firms, and U.S. multinational subsidiaries have played a large role in the industrial development of the country. These ties have led in some cases to complete transfer of plant equipment from the United States, and in others, to the design of industrial operations around plans of the U.S. firm, which included complete packages of laboratory instruments.

In the public sectors, including the universities, the preference for U.S.-made instruments has derived from other ties with the United States, primarily educational ones. Of the Venezuelan technicians and administrators trained abroad, most were educated in the United States where they became familiar with American procedures and equipment. Additionally, Venezuelan universities and technical schools have relied largely upon U.S. texts and other training materials. Also responsible for the introduction of U.S. equipment into the country have been the large American technical assistance programs.

Expansion of American sales is enhanced by the development of more advanced laboratory techniques in Venezuela. As the requirement for more complex instruments grows, end users increasingly favor American products, which enjoy the highest reputation for reliability, durability, and general performance.

According to trade sources, U.S. manufacturers generally provide better support for their products than suppliers from other countries, and delivery times from American sources are better than those from Europe or Japan. Nevertheless, both end users and distributors have emphasized the importance of providing written material relating to the use and servicing of the instruments in Spanish. Most third-country suppliers translate all such materials into Spanish; failure to do so can cause problems for operators and service personnel. Prompt attention to requests for service from Venezuela is also a key to success in the market.

The larger sales and service organizations in Venezuela that carry U.S.-made laboratory instruments are generally considered to show better performance than distributors handling third-country brands. Since most suppliers work through local distributors, the individual distributor's level of expertise is very important. Both American and other foreign suppliers now send some personnel to the home country or bring in technicians to lead short training sessions. Trade sources suggest, however, that better results could be obtained if U.S.-trained instructors conducted regular seminars for local distributors and if Venezuelan personnel from certain large end users were trained and familiarized with American equipment in the United States.

Hewlett Packard of the United States supplies about 80% of the Venezuelan market for gas chromatographs and is expected to gain a major share of the growing markets for mass spectrometers and X-ray analyzer equipment. This company, which maintains sales and service operations through its subsidiary, also provides excellent onsite training opportunities and various seminars on the use and technical construction of its equipment for end users.

Perkin-Elmer also supplies Venezuela with gas chromatographs and is reported to be the major source of atomic absorption equipment, infrared (IR) analyzers, and automatic analyzers. Corning, the leading market supplier for glass-related instruments and accessory laboratory items, is also an important provider of pH meters. American Optical is the chief U.S. supplier of microscopes.

Some other important American firms and principal products exported include Varian Associates (gas chromatographs, atomic absorption devices, and mass spectrometers); du Pont (mass spectrometers); and Beckman (gas chromatographs). Other U.S. companies participating in the market include Technicon, Bausch & Lomb Inc., Fisher, and Precision Scientific.

Third-country suppliers are expected to hold their 30% share of the market throughout the 1970's by concentrating on less advanced instruments with which they can maintain price competitiveness. Venezuela is increasing its trade with Latin American and East European countries. Much of the trade with the latter group is on a government-to-government basis; for some of the large government-controlled industries or institutes, this could lead to purchases of large packages of instruments.

Third-country suppliers lead in sales of only three kinds of instruments: electron and proton microscopes, precision balances, and pH meters. With regard to both electron and proton microscopes, price has been a major consideration; however, Japanese and German sales are largely attributable to the reputation of their optical techniques. Precision balances are largely supplied by Western Europe, also for reasons of price and quality. Third-country suppliers, led by Radiometer of Denmark, dominate the market for pH meters. Price is apparently the primary reason, since the products have not proved superior to U.S. products in performance or quality.

German firms participating in the market include Sauter, Metzler, Siemens, Erickson GmbH & Co. K.G., Jenaer Glaswerk Schott & Gen, Carl Zeiss, and Merk. Prominent United Kingdom companies include Rank Precision Instruments Co. and Cambridge Scientific Instruments Ltd.; Japanese firms include Hitachi, Shimadzu Seisakusko Ltd., Nikon, Jasco, Olympus, and Yokogawa. Also participating locally are Phillips and Enraf Monius of the Netherlands, Melron Herizan of Switzerland, Rochard of France, and Reickert of Austria.

Selected instrument markets. — According to research conducted for the Office of International Marketing, Bureau of International Commerce, sales of *gas chromatographs* are expected to rise from $360,000 to $700,000 between 1975 and 1979 (see table 2). The increase is primarily due to anticipated gas chromatograph use in the petrochemical, basic metal, and petroleum industries, all of which are being heavily developed by the Government. Other industries are also switching from simpler types of analysis to more advanced methods that may employ gas chromatography. Most gas chromatographs in use are considered basic; the lack of highly trained personnel is expected to hinder expansion into the more advanced techniques for the next few years. Prime users of gas chromatographs have been government institutions such as Instituto Venezolano de Investigaciones Cientificas (IVIC), the major research organization in the country; Instituto Venezolano de Petroquimica (IVP), for use in its petrochemical complexes; Instituto Nacional de Obras Sanitarias (INOS), for use in control of pesticides and other contaminants in the water supply; the Policia Tecnica Judicial (national police force), for detection of drugs; and large university laboratories. Sales have also been made to plants producing explosives and to large breweries.

Computerized systems are little used in Venezuela. However, the El Tablazo petrochemical complex uses one system, purchased from Hewlett Packard, that connects five gas chromatographs with a computer.

Table 2:— Venezuela: Sales of selected laboratory instruments, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	1974		1979	
	Total sales	U.S. sales	Total sales	U.S. sales
Gas chromatographs	360	342	700	640
Liquid chromatographs	50	48	200	180
Mass spectrometers	120	120	500	480
NMR spectrometers	—	—	100	100
pH meters	1,000	250	2,000	700
Densitometers	100	85	200	170
Thermal analyzers	50	43	200	170
Automatic analyzers	1,000	800	2,000	1,600
Electron microscopes	50	5	200	100
Balances	600	150	1,900	670
Atomic absorption devices	500	500	1,000	1,000

Source: Values based on Venezuelan trade source estimates.

Demand for *liquid chromatographs* is low in Venezuela because of the expense and lack of technicians trained to handle them; sales totaled only $50,000 in 1974. Nevertheless, certain larger industries are showing more interest in this type of instrument, and sales should reach $200,000 in 1979.

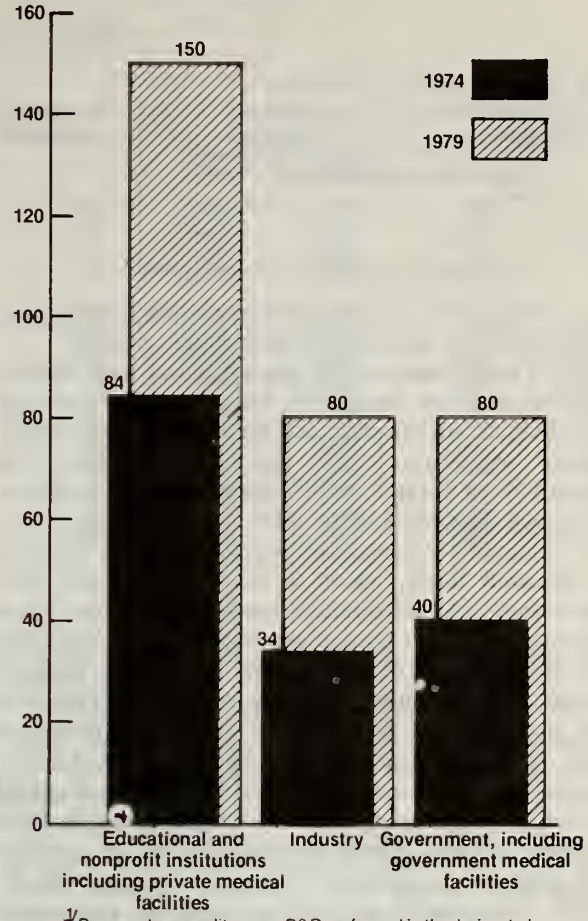
Hewlett Packard, Perkin-Elmer, and Varian Associates, plus du Pont, dominate this market. Third-country suppliers are not expected to be strong competitors within the next 5 years, although the source of supply for some U.S. equipment makers could be shifted to their operations in third countries. *High performance liquid chromatographs* (HPLC) are little used, and demand for them is not expected to grow significantly in the 1970's.

Because of their high unit cost, there were only four *mass spectrometers* in Venezuela in 1974, and these were located in universities and the IVIC. The demand for this instrument is anticipated to increase, and sales are projected to rise from $120,000 in 1974 to $500,000 in 1979. Perkin-Elmer and du Pont supply the entire market and are expected to continue to do so for reasons of price and quality.

No sales of *nuclear magnetic resonance (NMR) spectrometers* were reported in 1974. There are only two or three such instruments in the country, and IVIC is the chief user. The shift to more advanced methods of research in Venezuela may require the purchase of a few NMR spectrometers, but sales are not expected to exceed $100,000 in 1979. When such instruments are purchased, U.S. suppliers are expected to be the chief source, with price a prime consideration.

The major analytical device in use throughout Venezuela, found in almost all laboratories, is the *pH meter.* Demand is so strong that sales should easily double in the next 5 years to reach $2 million by 1979. Although many brands are sold, Radiometer of Denmark continues to dominate the market for pH meters. These items generally carry a small unit price relative to other instruments, and before the dollar's devaluation,

Figure 2. Venezuela: R&D expenditures[1] 1974 and projected 1979 (in millions of U.S. dollars)



[1] Represents expenditures on R&D performed in the designated sectors regardless of the original source of funds.

Source: Values based on Venezuelan trade source estimates.

European suppliers were able to offer lower prices than U.S. suppliers. The latter are forecast to increase their share of the market from 25% in 1974 to 35% in 1979, since their prices are now more competitive and their quality is undisputed.

Densitometers are used in a variety of industries such as food products and chemicals, as well as in universities and clinics, but sales have been relatively light. Use of these instruments will increase somewhat over the next few years as laboratory methods become more advanced. U.S. firms are expected to continue to supply 85% of the market by reason of quality and performance.

Sales of *thermal analyzers* amounted to only $50,000 in 1974, but as laboratory methods change, sales will probably reach the $200,000 level by 1979. No trend is yet visible concerning the types expected to be in demand. Although du Pont has a significant share of the market, many manufacturers participate. American equipment is preferred by virtue of its quality and performance, and U.S. suppliers are expected to maintain their 85% share of the market.

Automatic analyzers of the less complex type are widely used in Venezuela and account for a significant part of the overall market for automatic analyzers, which was valued at $1 million in 1974. With the expansion of laboratory use, demand for these instruments is estimated to double over the next 5 years. U.S. suppliers accounted for 80% of the market by virtue of price plus performance, and this domination is predicted to continue through 1979.

Only 13 *electron microscopes* were in use in Venezuela in 1974, but demand by the universities will help to push sales of these instruments from $50,000 in 1974 to approximately $200,000 by 1979. Hitachi of Japan currently supplies almost 90% of the market, but if U.S. suppliers were to become price competitive, they could increase their share from 10% in 1974 to 50% by 1979.

Basic types of precision *balances* are widely used in Venezuela, and the increase in research throughout the country is expected to boost sales from $600,000 in 1974 to nearly $2 million by 1979. Although many manufacturers participate in this market, suppliers from Germany are considered to have the largest share. As price becomes more of a factor, American suppliers are forecast to increase their market share from 25% in 1974 to 35% by 1979.

In Venezuela, *atomic absorption devices* are supplied entirely by U.S. firms and are becoming increasingly popular for use in liquid analysis. Perkin-Elmer alone has recently sold about 70 of these instruments, and demand is growing rapidly. Sales are therefore predicted to double between 1974 and 1979, with American dominance continuing because of satisfactory product performance.

Basic *proton microscopes* are in strong demand. Although European and Japanese suppliers held the majority of this market in 1974, sales of these instruments by American suppliers could increase significantly, given more competitive prices.

X-ray analyzers for laboratory use do not yet exist in Venezuela, but Hewlett Packard is vigorously attempting to sell them. *Oxygen analyzers* are little used, and shifts toward the use of chromatographs are expected to keep the demand for such equipment low.

Major Purchasers

Research and development funds will be concentrated through the 1970's in the general areas of agriculture, health and hygiene, and industry. Agricultural research accounted for more than 29% of total R&D funds in 1970. This field will remain important throughout the next 5 years, although that percentage has fallen off somewhat. On the other hand, industrial research, which accounted for 11% of the total in 1970, has increased its share. Health and hygiene accounted for almost 19% of R&D expenditures in 1970 and that share is expected to remain the same. Special focus is anticipated on matters relating to energy, particularly petroleum and natural gas, which dominate the Venezuelan economy; ecology, where pollution

Table 3.—Venezuela: Persons employed as scientists, engineers, and technicians in the physical and life sciences, 1974

	Scientists			Engineers	Technicians
	Physics	Chemistry	Other life		
Employed by:					
Government, including government Medical facilities	25	100	500	100	625
Industry	22	88	440	88	550
Educational and other nonprofit institutions, including private medical facilities	53	212	1,060	212	1,325
Total	100	400	2,000	400	2,500

Source: Data based on Venezuelan trade source estimates.

control legislation is in the process of formulation; mass transportation; and mineral and metal research.

R&D funds amounted to approximately $160 million in 1974, of which about 90% was spent for research in the physical, engineering, and life sciences. Laboratory-related expenditures were estimated to account for about 25% of the total. R&D expenditures are predicted to exceed $300 million by 1979 (see figure 2).

Venezuela's Government provides the vast majority of research funds, which it channels primarily into educational and government research institutes. Since the Government is directly involved in many industrial development projects, particularly those involving basic metals and petrochemicals, some of its funds also go to the industrial sectors, and this trend is expected to grow. The Government provided $130 million of 1974's total R&D funds, and it is expected to remain the chief source of funds through 1979, when it will supply $255 million. Industry, which furnished $20 million in 1974, will increase its contribution to about $50 million by 1979. Educational and other nonprofit institutions were the source of $10 million for R&D in 1974 and will double that figure in the next 5 years.

The Government provides general operating funds to educational institutions to use as needed for activities that include research. It also directly supports the IVIC. In support of other research activities, the government agency, Consejo Nacional de Investigaciones Cientificas y Technologicas (CONICIT), is the major source of funds throughout the economy, including those for the industrial sector.

As indicated in table 3, some 5,400 scientists, engineers, and technicians were estimated to be engaged in natural science research in 1974; more than 50% were employed in educational and other nonprofit institutions. Most of the 2,500 research scientists received university degrees in Venezuela; of those with advanced degrees, almost 33% studied in the United States. About 30% have advanced degrees from Venezuelan institutions, another 22% did graduate study in Western Europe, and 12% completed advanced degrees in Latin American countries other than Venezuela.

For some time R&D in Venezuela has been impeded by an acute shortage of trained research personnel. Except for the field of medicine, Venezuelans have preferred non-scientific disciplines for professional study. The government has worked in three ways to solve this problem. First, it increased funds for the development of scientific studies in the universities. Second, in 1970 with financial aid from international agencies, particularly the Inter-American Development Bank, it created a new technical/engineering institution in Caracas, the Universidad Simon Bolivar. By 1975 the school had an enrollment of 5,000 and had become the most prestigious educational facility in the country. And third, the Government has started a large program to provide an eventual total of 10,000 university scholarships to Venezuelans; many students will use them abroad, with the largest number slated to study in the United States. In the 1974-75 academic year, 3,368 scholarships were awarded for foreign study, and 1,810 for study within Venezuela.

Educational and nonprofit research laboratories. The 448 laboratories comprising this sector spent almost $18 million in 1974, $3.07 million of which represents purchases of instruments. Such purchases are projected to reach $5 million by 1979 (see table 4).

The universities together account for by far the greatest part of the research, and the most important individual institution for research is IVIC. In addition to conducting a variety of medical and other scientific projects, IVIC also serves as a training center for graduate work in science. Its laboratories are reputed to have the most advanced research instrumentation in the country, and it will remain a major user of instruments related to scientific and medical analysis. Some important sections of IVIC and the number of laboratories in each are the biophysical and biochemical center with 10 laboratories; microbiology and cellular center, 6; physics and chemical centers, 5 each; department of petroleum and petrochemicals and department of engineering, 4 each; departments of ecology, neurobiology, experimental medicine, anthropology, and nuclear technology, 3 each. Three of the largest laboratories outside the IVIC are located in the Universidad de los Andes in Merida, the Universidad Simon Bolivar, and the Universidad Central de Venezuala in Caracas. The latter has a big hospital laboratory; that engages in medical analysis of all types and employs about 80 persons, most of whom are physicians, chemists, or biologists. The principal types of instruments used are pH meters, densitometers, automatic

Table 4.—Venezuela: Laboratory expenditures by major end users, estimated 1974 and projected 1979

(in thousands of U.S. dollars)

	Number of laboratories	Laboratory expenditures		Purchases of laboratory instruments	
		1974	1979	1974	1979
Government	130	2,692	5,000	300	1,000
Educational and nonprofit institutions	448	17,990	30,000	3,070	5,000
Independent commercial laboratories	97	815	2,000	200	500
Medical organizations	330	10,375	20,000	2,000	3,000
Industry:					
Oil and gas extraction	12	300	1,000	50	5500
Food products	97	2,328	4,800	400	1,000
Chemical	72	2,592	5,000	600	1,300
Petroleum	42	1,000	2,800	100	1,000
Rubber and plastic products	12	300	600	70	100
Stone, clay, and glass	5	180	400	50	100
Primary metals	22	848	2,000	300	500
Fabricated metal products	12	300	1,000	100	400
Transportation	4	200	400	60	100
Other	16	450	1,500	100	400
Total	1,299	40,370	76,500	7,400	14,900

Source: Values based on Venezuelan trade source estimates.

analyzers, balances, and oxygen analyzers. Other parts of this university with laboratories include the chemical and medical colleges, 15 each; odontology college, 10; engineering college,8;physics and mathematics college, 6; biology college, 6; and pharmacy college, 5.

Although the more important users in this sector have a variety of laboratory instruments permitting the use of such advanced research methods as mass and NMR spectrometry and electron microscopy, the most commonly used research methods remain other spectrometric methods, chromatography, colorimetry, polarimetry, spectropolarimetry, and refractometry. Instrument demand will be related to expansion of current procedures and creation of new research facilities in the new universities. Two new government schools are the Universidad de los Llanos at Calabozo and the Universidad del Tachira at San Cristobal; the latter has been promised approximately $1 million for 1975, to be spent on laboratory construction. Universidad Simon Bolivar is currently expanding its laboratories and buying instrument packages under international bids. Of the two new private universities in Caracas, the Universidad Metropolitana is more important.

As yet there is no trend toward use of electronic data processing (EDP) equipment in university laboratory research. However, IVIC and the Universidad Central de Venezuela have shown interest in this approach and are expected to purchase instruments and computers as a package when they do decide to buy.

For the immediate future, instruments expected to be in highest demand include gas chromatographs, spectgrometers, colorimeters, IR detectors, densitometers, all types of analyzers, balances, centrifuges, proton microscopes, pH meters, polarimeters, and refractometers.

Medical laboratories.—As a result of government plans to expand medical services, medical analysis facilities and sales of laboratory instruments to equip them are expected to experience considerable growth. Purchases of laboratory instruments amounted to $2 million in 1974, accounting for approximately 20% of total medical laboratory expenditures. Instrument purchases are projected to reach $3 million by 1979.

All 330 medical laboratories are attached to hospitals and all restrict their activities to basic chemical and biological analysis related to medical operations, leaving experimental medical research almost entirely to the Universidad Central de Venezuela and IVIC. The laboratories in this sector employ 80 chemists, 10 physicists, and 460 other life scientists, mostly biologists and bioanalysts. The largest laboratories belong to the Centro Medico de Caracas, Clinica Instituto Medico la Floresta, Clinica el Avila, Clinica Luis Razetti, Hospital Central Fuerzas Armadas Nacionales, Hospital Universitario de Caracas, and Hospital Periferico de Coche.

The chief analytical methods in use are colorimetry, microscopy, chromatography, thermal methods, centrifugal analysis, and some spectrometry. No major shifts in methods or activities are expected in the foreseeable future, and no operations involving computers were reported.

The types of instruments expected to be in demand throughout the 1970's are amino acid, oxygen, and water analyzers; balances; colorimeters; chromatographs; proton microscopes; centrifuges; pH meters; polarimeters; and spectrometers.

Laboratories in the chemical industry.—Spurred by extensive government plans to develop the petrochemical sector, an increase in laboratory expenditures by the chemical industry from $2.6 million in 1974 to $5 million in 1979 is expected. Purchases of laboratory instruments are predicted to rise even faster in the same period, from $600,000 to $1.3 million. Annual chemical industry capital investments, which were estimated at $300 million in 1974, will probably reach $500 million by 1979. The majority of these funds are slated for production of products new to Venezuela and for the creation of several plant facilities, with a corresponding need for laboratories.

Production of the following products is to be begun or expanded: ethylene, propylene, chlorine, ammonia, urea, polystyrene, polyethylene, polyvinyl chloride (PVC), methanol, polyisoprene, phosphoric and sulfuric acids, diammonium phosphate, triple superphosphate, fertilizers, aluminum sulfate, styrene butadiene rubber (SBR), and polybutadiene. In addition, Venezuela is eager to enlarge its production of pharmaceuticals, with emphasis on greater use of local raw materials. These efforts will also require expanded R&D laboratory facilities.

The most extensive new area of development is the petrochemical complex at El Tablazo, started in 1969 under the aegis of IVP and aided by other state institutions and national and foreign investors. The initial phase, costing about $450 million and nearing completion in 1975, includes an ammonia/urea complex, an olefins plant, a styrene operation, a low-density polyethylene plant, and the necessary support infrastructure. A second stage, scheduled for completion in 1976 and estimated to cost $818 million, will include another olefins plant to produce ethylene and propylene, a PVC plant, an ammonia facility, and a vinyl acetate plant.

At Moron, the oldest IVP operation is being expanded. IVP plans investments of $77 million from 1975-1977 to create a new fertilizer complex. Joint ventures to begin in 1975 or later are planned to produce refrigeration gases, sodium phosphate products, aluminum sulfate, and SBR.

Two other new complexes are in the advanced planning stages. One planned for the eastern part of the country near Barcelona will require investments of $930 million and is scheduled to include two plants for processing LPG, two plants for production of ethylene, and four ammonia plants. The other, to be located near Paraguana and estimated to cost $47 million, is to utilize the naphtha produced by the Creole (Exxon) and Shell refineries for production of benzene, toluene, and xylene.

All of the foregoing projects are expected to include laboratory operations, but no estimates are available as to expenditures for instruments.

The approximately 72 laboratories of the chemical industry employ about 20 chemists, 60 biologists, 5 to 10 engineers, and 100 technicians. Some of the largest laboratories belong to IVP, Nitroven (a mixed company owned 50% by IVP, 40% by International Development Investment of the United States, and 10% by a Colombian firm), Creole Petroleum Corporation, Mobil Oil Company de Venezuela, Cyanimid de Venezuela C.A., Dow Quimica de Venezuela, du Pont de Venezuela C.A., Shell Quimica de Venezuela C.A., and Union Carbide de Venezuela C.A.

The principal analytical methods used in the industry are spectrometry, colorimetry, and chromatography, refractometry, and saccharimetry. The only extensive use of EDP equipment is in the Nitroven ammonia plant at el Tablazo.

Instruments expected to be in highest demand throughout the 1970's are gas chromatographs, colorimeters, balances, pH meters, proton microscopes, refractometers, spectrophotometers, and viscometers.

Laboratories in the food products industry. Primarily because Venezuela's Government has plans to greatly expand the sugar-refining industry and the processing of fish and seafood, sales of laboratory instruments in this sector, which totaled $400,000 in 1974, are expected to reach $1 million by 1979. General growth in other sectors of the industry will also require increased use of laboratory methods for process control and product quality analysis.

There are an estimated 97 laboratories within the industry. Estimates show 100 biologists, 20 chemists, and 150 trained technicians employed in the industry.

The largest laboratories include those of Venezolana Empacadora C.A. (meat products); Industrias Lactea Venezolana C.A., Industrias Lacteas de Carabobo S.A., Empresas Club C.A., Kraft de Venezuela C.A., and Concentrados Nacionales (dairy products); C.A. Venezolana de Alimentos, Industrias Yukery S.A., Alimentos Heinz C.A., and Compania Venezolana de Conservas C.A. (preserved fruits and vegetables); Grandes Molinos de Venezuela S.A., General Mills de Venezuela S.A., and Alimentos Kellogg S.A. (grain mill products); Nabisco la Favorita C.A., Fabrica de Galletas Puig, and Fabrica de Pastas Milani Hermanos C.A. (bakery products); C.V.F. Centrales Azucareros C.A. and Central El Palmar C.A. (sugar refining); Industrias Savoy C.A. and La India C.A. (confectionery manufacturing); Mavesa S.A. (fats and oils); Protinal C.A. (animal foods); and Alimentos Margarita C.A. (seafoods). While these laboratories are used primarily for quality control, the larger ones also conduct new product research.

The analytical methods most used in this industry are chromatography, refractometry, colorimetry, polarimetry, spectropolarimetry, and spectrometry. There were no computer operations reported or anticipated.

Instruments expected to be in demand through the 1970's are gas chromatographs; absorption meters; amino acid, carbon, hydrogen, nitrogen, oxygen, and water analyzers; balances; colorimeters; centrifuges; densitometers; infrared detectors; proton microscopes;

pH meters; polarimeters; spectrometers; and viscometers.

Construction of three highly automated government-owned mills is scheduled to begin in 1975, and at least four new privately owned mills are already being built. These mills will require quality-control laboratories, and the established mills that are expanding their operations will need additional analytical instruments.

Laboratories in other industrial sectors.—The largest laboratories elsewhere in industry are in the petroleum and basic metals sectors. Two of the largest refineries in the world, Creole and Shell, engage in extensive quality control and analysis. As for ferrous and nonferrous metals, the Government plans to invest about $3.5 billion over the next 10 years to expand the operations of its firm Siderurgica del Orinoco. Although details concerning laboratory instruments that will be required in both these industries are not available, opportunities for sales are expected to be considerable.

Trade and Technical Regulations

Venezuela's system of customs tariffs is based on the Brussels Tariff Nomenclature as modified for use by members of the Andean Common market. The modifications, which Venezuela adopted in September 1974, are still in the process of being clarified. Some confusion stems from the fact that various instruments and parts can be imported under more than one category; moreover, some large installations, which include instruments, can be imported as a package under one classification.

Customs duties on laboratory instruments range from 1% to 5% based on the ad valorem value of the shipment. In addition, all imports are subject to another 3% ad valorem tax based on the c.i.f. value. With few exceptions, no licenses are required. Current information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 10130. Trade sources advise U.S. suppliers new to the market to consult local customs brokers for assistance in determining the exact category description for their instruments, as well as for general help in importation procedures.

As yet no specific technical standards have been established for imported laboratory instruments. To date, products from the United States have been the accepted model. Gages and other measuring scales should be marked according to the metric system.

An agency within the Ministry of Development is studying various industrial norms for items produced within the country; in the future it could enact regulations related to laboratory instruments. Current information on the availability of published standards for laboratory instruments for Venezuela may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Other detailed marketing information on Venezuela is available on a continuing basis from:

Country Marketing Manager-Venezuela
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

A copy of the original research which this Country Market Survey summarizes is available at a cost of $10.00 from:

National Technical Information Service
U.S. Department of Commerce
P.O. Box 1553
Springfield, Virginia 22161
Sales desk telephone: (703) 321-8543

The report includes more detailed information on U.S., foreign, and local firms active in the market and their products. Additional marketing information in the report includes a more extensive assessment of end users and listings of major prospective customers, trade publications and trade and professional associations. Please request: "The Market for Laboratory Instruments— Venezuela," DIB 75-07-507, March 1975.

Country Market Briefs

Summaries on six additional country markets for laboratory instruments are contained in this section. These summaries, containing key market data, are based on reports prepared by the commercial sections of the U.S. Embassies and Consulates in the surveyed countries.

Belgium

The Belgian market for laboratory instruments is expected to increase at an average annual rate of about 8% from 1974 through 1979, advancing from about $21 million[1] in 1974 to an estimated $30 million in 1979. Belgium requires a steady supply of laboratory instruments to help keep its highly industrialized, export-oriented economy competitive in world markets.

In 1974 imports accounted for about 97% ($20 million) of Belgium's laboratory instrument market, of which the U.S. share was approximately 10%, or $2 million. By 1979 imports should approach $30 million, with purchases from American firms totaling $3 million.

Belgians continue to regard the United States as a world leader in laboratory instrumentation. With only a few exceptions, American suppliers have a virtual monopoly on high-technology equipment. These suppliers also have most of the market for automated, computer-linked equipment, where the European competition thus far has failed to offer much of a challenge. The market for certain types of U.S. origin laboratory equipment (such as gas chromatographs) is being displaced by American production in Europe and by serious competition from other producers in Europe and Japan. The U.S. market position in Belgium for microscopes and balances is insignificant.

Major Purchasers

Belgium's chemical industry is one of the largest in the world. Sales in 1973 were over $4 billion and appear to have risen 17% in 1974. Investment in 1973 was $375 million and is estimated to be $650 million in 1979.

Chemical firms in Belgium number around 700, but basic research is carried out only by the 10 largest. The most important laboratory among these is the big Belgian multinational Solvay, which employs over 1,000 persons in petrochemical research. Other large laboratories include Janssen, Union Chimique Belge, Agfa-Gevaert, and Essochem.

Technical experts in the chemical industry do not expect any striking change in demand for laboratory instruments through the end of this decade. Gas chromatographs will continue to be their most important tool, particularly in petrochemistry. Automated gas chromatographs, often linked with other equipment, are growing very popular for technical use and economy. Liquid chromatography also will see increasing use, and demand is likely to grow for the highly sophisticated analysis available from nuclear magnetic resonance and infrared spectrometers, particularly as the former's price drops and the latter's use increases for pollution measuring applications. More instrumentation for research on polymers is likely to be in demand.

The Belgian university system is another important purchaser of high-technology laboratory equipment. The Belgian Government provided operating subsidies to the universities estimated at $410 million for 1975. Perhaps 2% of this total, or about $8 million a year, goes toward the purchase of laboratory instruments.

There are currently 11 science departments, 8 engineering departments, and 7 full medical schools within the university system. They include an estimated 80 laboratories in science and engineering and perhaps 150 in medicine. The total number of scientists and technicians involved is between 10,000 and 15,000. Science and engineering professors would like to expand their capabilities in polarography, electron spectroscopy, and secondary ion mass spectrometry for chemical analysis, as well as electronic data processing.

Private and public biochemical laboratories have expanded in recent years due to an increased reliance on specimen analysis by younger doctors, and a liberal government medical insurance program. The number of these laboratories has grown to an estimated 400, perhaps 100 of which have an annual budget exceeding $375,000. Biochemical sample testing is estimated to have increased an average of 20% annually between 1965 and 1975. Local sources expect activity to plateau over the next several years, primarily because of government cutbacks in medical insurance payments.

The largest biochemical laboratories in Belgium are attached to the medical schools of the four state universities at Brussels, Louvain, Ghent and Liege.

The Brussels and Liege university laboratories are the biggest, both doing about one million analyses a year, and probably each investing over $250,000 annually in equipment. While spending on equipment

Belgium: The market for laboratory instruments, 1974, 1975 and 1979

(in millions of U.S. dollars)

	1974	1975	1979
Production	.7	.7	1.0
Imports	20.4	21.0	30.0
Exports	.5	.5	.8
Market size[1]	20.6	21.2	30.2

[1] Market size equals production plus imports minus exports.

Source: Based on data supplied by the Belgian National Institute of Statistics.

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[1] All values are shown in U.S. dollars. Local currency data was converted at the following exchange rate US$1=BF39.

in general by these larger laboratories is not likely to grow as fast as in recent years, demand may increase nonetheless for certain products, especially high-efficiency, high-volume testing equipment, including automated blood and urine analyzers, liquid chromatographs, scintillation counters for Gamma/Beta measurement, instruments for enzyme analysis, protein electrophoretic analyzers, hematology pattern diagnosis systems, as well as automated systems in immunology and bacteriology.

Korea

From 1972 to 1974 Korea's market for laboratory instruments grew nearly 30% a year. It increased from $2.7 million in 1972 to $4.5 million in 1974 (see table). The market is forecast to increase at an even faster rate through the remainder of the seventies. Local trade sources anticipate that sales will approach $25.5 million in 1979, up more than 40% annually from the $6.3 million estimated for 1975. Their projections for such a dramatic growth rate are based on increasing governmental promotion of an indigenous research and development (R&D) capability to upgrade the quality of the nation's industrial output.

Continued reliance on foreign manufacturers for virtually all laboratory instruments is expected to boost Korea's imports of these products from $4.3 million in 1974 to $25 million in 1979. Despite the probability of intensified competition from third-country producers, U.S. exporters should improve their position in view of a trend favoring purchases of high-precision laboratory apparatus. Imports from the United States are projected to climb from $1.2 million in 1974 to nearly $8.8 million in 1979, indicating an expansion in the U.S. share of the import market from 28% to 35% over the 5-year span.

American manufacturers' chief competitors are Japanese producers, who have made stronger inroads in the Korean market because of their proximity to the marketplace, the lower prices of their products, and the traditional commercial ties between the two countries. Most Japanese-made laboratory instruments sold in Korea, however, are much less sophisticated than the American-made equipment on the market. When the purchaser's required level of precision decreases, the most desirable features of U.S. instruments (durability, consistency, accuracy and ease of recalibration, ease of maintenance and repair) tend to be sacrificed in favor of the lower price and faster delivery available from Japan.

Major Purchasers

Outside of some limited research activity by a few major universities, the Korean Institute of Science and Technology, and a handful of small research institutes, R&D in Korea has been confined to investigating quality control techniques and to analyzing foreign technology for possible adaptation to Korean requirements. Basic research, however, is beginning to play a more important role as a result of efforts by the Ministry of Science and Technology to foster the development of new and more sophisticated laboratories in industry and in the existing and planned research institutes, as well as in the schools and universities which will train the professionals and technicians to run them. These efforts are aimed at achievement of internationally competitive standards of quality by Korea's industrial establishment, a goal which will depend heavily on adequate analytical facilities and trained personnel.

R&D concentration in the latter half of this decade is expected to be in chemical and industrial engineering, electronics, agriculture, and public health. Total R&D funds in Korea are projected to rise 25% annually from $49 million in 1974 to $150 million in 1979. During this period, private industry is expected to contribute one-quarter of the funds while using only one-fifth in their own laboratories; the Government is expected to provide, and spend, the remainder.

Most government-conducted research is carried out in various institutes and in some university laboratories. The Korea Institute of Science and Technology is now the major locus of R&D, performing contract research for private industry and the Government in the fields of chemicals, metals, electronics, food processing, and nonelectrical machinery. A much greater number of research projects, however, will be conducted at several specialized research institutes being planned for Dae Duk Science Town. The first stage of construction for five industrial research institutes (shipbuilding, ocean development, mechanical engineering, petroleum, and electronics) is scheduled to be completed by 1978, and 12 other government research institutes now located in Seoul should be moved to the town by 1981. According to the Ministry of Science and Technology, the cost of equipping the five industrial research institutes will exceed $10 million.

Other important government-owned laboratories include the Agency for Defense Development, the Korea Atomic Energy Research Institute, the Korea Advanced

Korea: The market for laboratory instruments, 1972, 1974 and 1979

(in thousands of U.S. dollars)

	1972	1974	1979
Production	50	400	1,000
Imports	2,713	4,273	25,000
Exports	23	170	500
Market size[1]	2,740	4,503	25,500

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[1] Market size equals production plus imports minus exports.

Source: Values based on Korean trade source estimates and projections.

Institute of Science, the Fine Instruments Center, the National Geological Survey and Mining Research Institute, the Ocean Research and Development Institute, the Mechanical Engineering Research Institute, and the Shipbuilding Industry Technical Services Institute.

Within the private sector, most laboratories are found in the chemicals, electronics, and basic metals industries. Trade sources indicate that a likely development in the sector during the next decade would be the establishment of clinical laboratories for contracted medical analysis on behalf of physicians. At present many physicians operate in small clinics and maintain their own laboratories, but the increasing cost and sophistication of analytical techniques should lead to the closing of the small less efficient facilities in favor of larger laboratories that will perform analyses for several physicians.

Malaysia

The Malaysian market for laboratory instruments has grown phenomenally in the last few years. Total sales rose from nearly $5 million in 1972[1] to over $32 million in 1974 (see table). This exceptionally high growth rate is expected to level off in the future, and 1979 purchases are predicted to top $40 million.

The entire Malaysian market for laboratory instruments is imported. A very small percentage is then reexported to other buyers.

U.S. manufacturers have dramatically increased their share of this market. Sales of American goods accounted for 14.6% of all imported instruments in 1972, or close to $800,000; 2 years later, the share had grown to 41.5%, or $13.7 million, and that proportion is expected to hold steady at least through 1979. Chief competitors are British, German and Japanese companies.

American laboratory instruments have a very good reputation among Malaysian users for quality and back-up service. Products with the best sales potential for U.S. manufacturers include gas and liquid chromatographs and all types of analyzers. No market has yet developed for electronic data processing equipment (EDP), but sales of entire systems, incorporating both instruments and computers, are considered likely in the future.

Major Purchases

The recent worldwide recession affected Malaysia very little; the country's gross national product has continued expanding at a healthy 5% annually. Government expenditure is determined by a Federal Five Year Plan, which concentrates on agricultural development and education. Government laboratories purchase approximately 35% of the instrument market. In 1974 this amounted to $11.2 million; in 1979 the figure should reach $14.1 million.

The major thrust of government-sponsored research in Malaysia is in agriculture. The principal agencies involved are: the Malaysian Agricultural Research and Development Institute, which works in food technology and animal improvement (with an annual laboratory budget of over $8 million); the Rubber Research Institute of Malaysia, researching all aspects of this crop ($12.5 million); the Standard Institute of Malaysia, concerned with development and imposition of national standards ($3.3 million); the National Institute for Scientific and Industrial Research, a new organization doing a wide range of research for small- and medium-sized Malaysian companies; and the Veterinary Department, which operates both diagnostic and research laboratories. Most of these agencies have just completed new facilities.

Major purchases of laboratory instruments are also anticipated from the National Electricity Board, which will soon be building the country's first nuclear reactor.

Scientific and technological education is actively promoted by the Malaysian government. The nation's largest technical school, Ungku Omar Polytechnic, expects a 30% annual rise in enrollment over the next few years. Another facility, the Polytechnic School at Kuantan, is scheduled to open in 1976, and 20 other technical and vocational schools throughout the country are currently in varying stages of construction.

Malaysia's five main universities account for about 70% of the educational sector's use of laboratory instruments. These schools also anticipate a 30% annual growth in enrollment. The institutions and their expected annual outlays for laboratory facilities are: the University of Malay, with an excellent teaching hospital and important schools of engineering, medicine, dentistry and science ($400,000); the University of Science, teaching biological, chemical, physical pharmaceutical and other forms of science ($1.8 million); the University of Agriculture, with courses in veterinary medicine, forestry and ecology besides standard agriculture ($1.1 million); the National University, with schools of medicine and science ($4.4 million); and the University of Technology, with courses in all areas of engineering ($400,000).

Because the Malaysian Government seeks to promote more wide spread participation by all the nation's racial groups in the economy, government orders can be placed only through Bumiputra (native Malay) agents. Companies with no regular agent in the country must submit bids through Bumiputra representatives.

Malaysia: The market for laboratory instruments, 1972, 1974 and 1979

(in millions of U.S. dollars)

	1972	1974	1979
Imports	5.3	32.7	40.8
Exports	.3	.5	.6
Market size[1]	5.0	32.1	40.2

[1] Market size equals imports minus reexports, since there is no domestic production. Imports exceed the market size because a portion of the imports are reexported.

Source: Values based on Malaysia trade source estimates and projections.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rates US$1=M$2.82 (1972), M$2.25 (1974 and subsequent years).

Philippines

U.S. manufacturers of laboratory instruments and equipment will continue to find excellent sales opportunities in the expanding Philippine market. Total imports which constitute virtually the entire market grew from an estimated $5.6 million in 1973[1] to almost $9 million in 1975 and are expected to reach nearly $20 million in 1980.

Growth in the demand for laboratory equipment can be attributed to the expansion of Philippine industries, particularly food processing and pharmaceutical manufacturing, continued governmental spending for research and development (R&D) in a variety of fields, and governmental efforts to improve health services, including the building of rural community hospitals and the upgrading of existing national and regional hospital and health centers.

U.S. suppliers are in a good position to capitalize on the country's growing need for laboratory equipment. Philippine scientists, many of whom were trained in the United States, recognize American manufacturers as world leaders in technology and design and in quality, reliability and variety of products offered. This technological capability gives American suppliers a decided sales advantage.

U.S. firms are the leading suppliers of laboratory instruments. The 1974 market share was almost 42% representing over $3 million in sales. Purchases of American manufactured laboratory instruments is expected to exceed $9.1 million in 1980 or almost 47% of the import market. U.S. sales opportunities are particularly favorable for pH meters, high performance liquid chromatographs and gas chromatographs, analytical balances, spectrophotometers, colorimeters, micrometers, titrimeters and amino acid analyzers.

Other leading suppliers of laboratory instruments and equipment are Japan and Germany. In 1974 Japanese manufacturers held almost 35% of the market. The Japanese are considered the major suppliers of laboratory optic equipment.

Major Purchasers

General research areas that are likely to draw R&D funds through 1980 are agriculture, natural resources, health, biomedicine, and ecology. Governmental R&D funds were formerly drawn from the General Fund and Special Science Funds. However, with the proclamation of Presidential Decree No. 711, which abolished all special funds, all budgets for scientific and technological research are currently derived from the General Fund. The United Nations Development Program (UNDP), the World Bank and the Asian Development Bank are also a source of R&D funds.

Private industrial firms equipped with laboratory facilities for applied research and quality control do not have fixed R&D budgets. Funding is generally flexible depending upon equipment needs and the size of a particular company.

The government sector will be a major growth area for sales of laboratory equipment. Total identifiable R&D funds (not including the State University) for 1975 were estimated at $21.4 million, or less than 1% of the entire Philippine Government budget. The 1980 budget is projected to top $55 million. The National Science and Development Board has the largest share of the R&D budget ($10.3 million in 1975, an estimated $30.4 million in 1980).

Approximately 40 to 50% of the State University's annual budget ($1.6 million in 1975) is spent on scientific and technological R&D. Approximately 70% of the equipment in the various scientific laboratories is of U.S. origin. In the future the University plans to establish a Zoology Research and Laboratory building at an estimated cost of $640,000 and to acquire additional research equipment valued at $300,000 for the Centralized Analytical Laboratory at Los Banos.

The Government also helps support the Metal Industries Research and Development Center (MIRDC), a nonprofit technological service organization. It is estimated that MIRDC will purchase over $3 million worth of instruments over the next 5 years.

The Philippine Government has several ambitious hospital and clinic development programs underway. The Department of Health will construct 11 regional training centers and 205 rural health facilities. In addition, Medicare health centers will be constructed under Phase II of the Philippine Medicare Program. Finally a Philippine Medical Center has been pro-

Philippines: The market for laboratory instruments, 1973, 1976 and 1980

(in thousands of U.S. dollars)

	1973	1976	1980
Production	—	—	5
Imports	5,646	10,402	19,493
Exports	34	2	5
Market size[1]	5,612	10,400	19,493

[1] Market size equals production plus imports minus exports.

Source: Data based on information supplied by the National Census and Statistics Office.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rate US$1=P7.5.

posed which will cost $225 million and contain 1,500 beds.

According to the Philippine Securities and Exchange Commission, the food products industry is the most profitable industry in the entire economy. In 1973 net sales of the top 75 food manufacturers were over $500 million. Trade sources predict that the development of additional processed food industries as well as new growth in the manufacture of several traditional food products will definitely require the establishment of new, and the expansion of existing, food laboratories for applied research, quality control, product development, and testing and evaluation of raw materials.

The combined sales of 23 top drug manufacturing firms was $108 million in 1973, up almost $15 million over the 1972 total. Pharmaceutical production is expected to accelerate as costs of importing finished goods increase and as drug consumption rises with increased population and stepped-up government health programs. Increased production will necessitate additions to existing research facilities thereby creating a demand for analytical laboratory instruments.

Singapore

The market in Singapore for laboratory instruments is expected to increase at an average annual rate of about 13 to 14% from 1974 through 1979, advancing from approximately $11 million in 1974[1] to an estimated $21 million in 1979 (US$1.00=$2.40).

Imports accounted for 100% of Singapore's laboratory instrument market in 1974 ($11 million), of which the U.S. share was approximately 40%, or $4.5 million. By 1979 imports are projected to reach $21 million, with purchases from American firms accounting for about 44% or $9.3 million.

Perhaps the largest potential growth area for U.S. imports is medical laboratory instrumentation. U.S. industry currently controls approximately 50% of the total market, compared with less than 30% which it shared with Germany, France, and Japan in 1970. It is estimated that the U.S. share could reach as high as 70% in the next 5 years. The increase is attributed to (1) the new levels of technical advancement in the United States in recent years, (2) the de-emphasis in purchase of U.K.-manufactured equipment as English physicians have transferred home in considerable numbers and acceptance of U.S. laboratory methods has grown, and (3) more competitive pricing due to changing exchange rates.

Major Purchasers

The Government of Singapore is the largest single user of laboratory instruments. The Ministry of Education is the most significant purchaser since it invests heavily in schools and currently maintains over 150 laboratories in secondary and higher-level institutions. Laboratories are well equipped for physical and chemical analysis. Expenditures for instruments were budgeted at over $3 million for 1974.

Medical facilities make up the sector exhibiting the highest growth rate in instrumentation purchases, with the Government investing heavily in major fully equipped analytical facilities and subordinate units. Total medical laboratory instrument expenditures surpassed $1 million in 1974, and are projected to increase 25 to 30% annually for at least the next 3 years.

Products of particular interest for the next 5 years are: balances, centrifuges, colorimeters, refractometers, pH meters, oscilloscopes, and thermometers.

The petroleum industry with expenditures for laboratory instruments averaging $1.5 million annually is probably the second largest customer in Singapore. Each of the five major oil refineries has large, well-equipped laboratories staffed by professional chemists and trained technicians. The continual expansion since the 1960's of Singapore's refinery complexes has eased, and though several refineries are still in planned expansion phases, a leveling off of laboratory expenditures is foreseen over the next 3 to 4 years. Total 1973 capital expenditure for the industry was a little over $142 million.

The five large refinery laboratories employ approximately 60 chemists and technicians. The laboratories primarily conduct petroleum testing and quality control analysis for content of sulfur, wax, gases, and impurities. Several laboratories contract analysis services to exploration firms and tankers, and provide other customer services. Analytical methods used in petroleum laboratories include chromatography, colorimetry, spectrometric methods, refractometry and electron paramagnetic resonance (EPR). Although there are a number of smaller commercial laboratories performing petroleum analysis and testing, the bulk of the instrument market, perhaps as high as 80%, is accounted for by the five large laboratories within the major refineries. These are: BP Refinery Singapore Pte. Ltd., Shell Eastern Petroleum (Pte.) Ltd., Esso Singapore Pte. Ltd., Mobil Oil Singapore Pte. Ltd., and Singapore Petroleum Co. Pte. Ltd.

The types of laboratory instruments expected to be in demand in the refining industry over the next 5 years are: analyzers (air, oxygen, moisture, sulfur), pH meters, potentiometers, spectrophotometers, spectrometers (flame), thermometers, viscometers, laboratory balances, barometers, colorimeters, laboratory centrifuges, gas chromatographs (flame ionization detecting, thermal conductivity detecting), hydrometers, infrared detectors, manometers, refractometers and pyrometers.

While no major research programs are envisaged by the refineries within the next 5 years, rsearch in air pollution control may be stepped up as the Government of Singapore stiffens its fuel sulfur content requirements.

Singapore: The market for laboratory instruments, 1974, 1975 and 1979

(in millions of U.S. dollars)

	1974	1975	1979
Imports	11.2	12.7	21.2
Exports	1.6	1.8	5.0
Market size[1]	9.6	11.0	16.2

[1] Market size equals imports minus exports since there is no domestic production. Imports exceed the market size because a portion of the imports are reexported by Singapore.

Source: *Singapore External Trade Statistics*, 1974, compiled by Department of Statistics.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rate US$1=S$2.4.

Switzerland

Switzerland has the highest per capita research and development (R&D) expenditure in the world; this expenditure is due largely to the technical orientation of the nation's industry. Total annual outlays for R&D exceed $1 billion,[1] of which about 12% is spent for laboratory instruments. Purchases of instruments rose from $30.1 million in 1972 to $34.3 million in 1974; projections place the value of the 1979 instrument market at nearly $40 million. The majority of these purchases are accounted for by the chemical and pharmaceutical industry, which has a continuing demand for technically advanced instruments. The increasing importance of pollution monitoring and control will further expand the market.

Switzerland relies on foreign manufacturers for most laboratory instruments. In 1974, imports totaled nearly $31 million; by 1979 foreign sales should grow to almost $35 million.

U.S. firms hold a significant position in the market with sales of $16.5 milion in 1974. Trade sources predict that American suppliers will maintain their 53% of the import market through 1979. Advanced U.S.-made instruments, particularly those incorporating sophisticated electronic components, are preferred by Swiss end-users because of their high quality and versatility. Instruments holding the greatest sales potential for American manufacturers include: analytical instruments for industrial and medical laboratories, pollution monitoring and control instruments and items related to nuclear research. Swiss buyers pay particular attention to quality, technical sophistication and after-sales service in their purchase decisions.

Although substantial in terms of dollar value, domestic production of laboratory instruments is limited to a few high-quality items. World renowned manufacturers such as Mettler Instruments are located in Switzerland. As a result, many of the instruments made locally are exported. Domestic production totaled nearly $32 million in 1974 while exports exceeded $28 million.

Major Purchasers

Private industry purchases the major share of laboratory instruments in Switzerland. About 20 firms comprise the bulk of private customers. The chemical industry is the largest single user of laboratory instruments, accounting for about 30% of the entire market. Chemical manufacturers operate an estimated 230 laboratories staffed by 3,124 professional researchers. Of the $655 million total industrial expenditure for R&D in 1974, $425 million was made by this sector. The chemical industry's R&D is concentrated in the fields of biochemistry and health.

By far the largest and most prestigious Swiss chemical firms are CIBA-Geigy, Hoffman LaRoche and Sandoz. The real growth of these three companies averages 10% annually, and they provide approximately 40% of total local pharmaceutical production and 30% of dyestuffs. Continued product development and improvement is an important factor in the success of these firms, and so they support extensive R&D programs. Their 1973 R&D budgets were: Hoffman LaRoche—$265 million; CIBA-Geigy—$240 million; Sandoz—$140 million. About 1,800 smaller chemical manufacturers also engage in R&D.

An estimated 10 to 15% of total laboratory budgets is spent for sophisticated analytical instruments. Products of increasing interest to Swiss buyers include: liquid, gas, liquid column and thin layer chromatographers; mass, IR and UV spectrometers; colorimeters; instruments relating to particle measurement and counting; laboratory centrifuges; and X-ray and ultrasound testing equipment. Many companies (and universities) now buy only computer-compatible equipment.

Universities constitute the second major end-user sector for laboratory instruments in Switzerland. Seven cantonal schools, the Federal Institute of Technology, the Swiss Institute of Nuclear Research and the Federal Institute for Reactor Research purchased instruments worth $9 million in 1974. Their laboratory budgets have declined somewhat since then, but are expected to rise again in the near future. University laboratories often have more up-to-date equipment than their industrial counterparts, and their personnel generally keep more current in the field. Areas expected to see

Switzerland: The market for laboratory instruments, 1972, 1974 and 1979

(in millions of U.S. dollars)

	1972	1974	1979
Production	25.1	31.7	38
Imports	26.2	31.0	35
Exports	21.2	28.4	33
Market size[1]	30.1	34.3	40

[1] Market size equals production plus imports minus exports.

Source: Values based on Swiss trade source estimates and projections.

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[1] All values are shown in U.S. dollars. Local currency data are converted at the following exchange rate US$1=SF2.5.

increasing purchases are electronic data processing, computer-compatible equipment and instruments used in pollution control research.

Sizable purchases of laboratory instruments are also made by Federal, cantonal and municipal governments. This heterogeneous sector includes about 85 laboratories of differing size, quality and purpose. In 1974 they bought equipment valued at $6.8 million. Generally they work in such areas as water and food quality, hygiene, police matters and pollution and waste control.

U.S. Government Services for American Exporters

MARKETING ASSISTANCE AND INFORMATION SERVICES

U.S. Trade Promotion Facilities Abroad

U.S. trade promotion facilities abroad provide U.S. manufacturers with a unique method of testing and selling in key foreign markets through commercial show rooms established in central marketing areas where the potential for American products is continuous.

Listed below are the 16 U.S. trade promotion facilities located in major cities in Europe, Asia, Australia and Latin America.

AUSTRALIA—U.S. Trade Center
37 Pitt Street
Sydney NSW 2000

AUSTRIA—U.S. East-West Trade Development Office
Prinz Eugen Strasse 8-10
A-1040
Vienna

FRANCE—U.S. Trade Center
123 Avenue Charles de Gaulle
92200 Neuilly
Paris

GERMANY—U.S. Trade Center
Bockenheimer Landstrasse 2-4
D-6000 Frankfurt/Main

IRAN—U.S. Trade Center
61 Queen Elizabeth II Boulevard
P.O. Box 50
Tehran

ITALY—U.S. Trade Center
Via Gattamelata 5
20149 Milan

JAPAN—U.S. Trade Center
Tameike Tokyo Building
1-14 Akassaka, 1-Chome
Minato-Ku
Tokyo 107

American Merchandise Display Center
Sankei Kaikan Building
27, Umeda-Cho, Kita-Ku
Osaka

KOREA—U.S. Trade Center
American Embassy
82 Sejon-Ro
Seoul

MEXICO—U.S. Trade Center
Apartado Postal M-2805
Mexico City 1, D.F.

POLAND—U.S. Trade Development Center
Ulica Wiejska 20
Warsaw

SINGAPORE—U.S. Trade Center
268 Orchard Road
Yen San Building
Singapore 9

SWEDEN—U.S. Trade Center
Vasagatan 11
Stockholm

TAIWAN—U.S. Trade Center
Taiwan Glass Co. Bldg.
261 Nanking East Road
Taipei

UNITED KINGDOM—U.S. Trade Center
4/5 Langham Place
London W1

U.S.S.R.—U.S. Commercial Office in Moscow
c/o American Embassy
Department of State
Washington, D.C. 20520

Information on exhibitions at trade promotion facilities abroad may be obtained from Country Marketing Managers or Commerce district offices.

Country Consultants

Country Marketing Managers (CMMs) provide U.S. firms with marketing information by specific country, counseling on the preparation of effective marketing plans, aids in selecting best opportunity markets and assistance in participating in Commerce trade promotion activities. The CMM also can assist in obtaining other foreign business information available within the U.S. Government.

In addition, the CMM's receive an enormous quantity of information, both published and unpublished, on their countries. This data comes from private and public sources, American and foreign. It includes periodic reports received from the commercial sections of U.S. Embassies on selected industries or product categories, "best prospects" for sales in the coming year, and new developments and opportunities of special interest to the U.S. business community.

The Country Marketing Manager provides guidance and direction in commercial activities to the U.S. Foreign Service—Department of State, Trade Center Staffs, Commercial Fairs staffs, and other trade promotion personnel. This includes the planning and implementation of trade promotional activities listed earlier ("Global Marketing Program") within the respective country or countries. The CMM is the focal point in Commerce for the development and implementation of the annual Country Commercial Program, jointly prepared by Commerce and the Foreign Service. This operational planning document establishes objectives and priorities for U.S. Government trade promotion and support of U.S. business by country, and the actions to be undertaken to achieve them.

Popular among American businessmen seeking up-to-date foreign marketing data are the International Marketing Information Series publications (see inside front cover). They are all available through CMMs.

For further information and assistance on marketing abroad, please call or write the appropriate manager (see inside back cover for list).

Export Information Services

The export information services described below can be obtained by contacting the U.S. Department of Commerce, Office of Export Development, Export Information Division, Room 1033, Washington, D.C. 20230, or the nearest of the Department's 43 district offices (listed on inside back cover).

Trade Lists

Names and addresses of foreign distributors, agents, purchasers, and other firms are made available to U.S. firms through a series of trade lists. *Business Firms Trade Lists* cover all commercial establishments in smaller developing countries. State *Trading Organizations Trade Lists* name and describe government-controlled foreign trade organizations in nonmarket economy countries.

World Traders Data Reports

World Traders Data Reports (WTDR's) provide descriptive background information on specific foreign firms. Prepared by the U.S. Foreign Service, the WTDR's include such information as year of establishment, method of operation, lines handled, size of sales territory, name of chief executive, general reputation in trade and financial circles, names and addresses of credit sources, names of the firm's connections, and other commercial information. The complete name, street and city address of the foreign firm must be given when requesting this service. Nominal fee.

Agent/Distributor Service

The Commerce Department's Agent/Distributor Service helps U.S. firms find agents or distributors for their products in almost every country of the world. U.S. Foreign Service Officers overseas will identify up to three foreign firms that express interest in a specific U.S. proposal. The charge for this service is $25. Application forms (DIB-424P) may be obtained from any Commerce Department District Office.

Export Mailing List Service

The Export Mailing List Service (EMLS) provides lists of foreign firms considered prospective customers for U.S. firms. Firms are drawn from the automated Foreign Traders Index. Their names and addresses are available on gummed mailing labels or in standard printout form. Printouts also include: Name and title of an officer, type of organization, year of establishment, relative size, number of employees and salespersons, and product and/or service codes (Standard Industrial Classification numbers).

A nominal "set-up" charge also covers the first 300 entries retrieved. Beyond 300, a small additional cost per name is charged. Delivery can be made in about 15 days.

Foreign Traders Index (FTI) Data Tape Service

This service is offered as a convenience to firms that have a continuing need for a broad range of foreign commercial data, such as export management firms selling a wide range of products. This service provides, in magntic tape form, information on all firms in one or more countries covered in the Foreign Traders Index. Users may thus retrieve various segments of FTI data by running tapes through their own computer facilities. There is a flat fee for this service on a per-country basis for up to 15 countries. A single, fixed charge is made for a package of 15 or more countries or for the entire file.

Overseas Business Opportunities

The overseas business opportunities services described below can be obtained by contacting the U.S. Department of Commerce, Office of Export Development, Overseas Business Opportunities Division, Room 2323, Washington, D.C. or the nearest of the Department's 43 district offices.

Trade Opportunities Program

The Trade Opportunities Program (TOP) receives up-to-date trade leads from U.S. Foreign Service posts around the world and disseminates them to U.S. suppliers. Trade opportunities are based on inquiries by overseas companies that wish to purchase American products or services, or who are interested in representing U.S. firms. Trade opportunities may come from private commercial organizations, from foreign governments, or even from multinational organizations such as NATO or the UN.

To register for TOP, U.S. firms are requested to specify their product and country interests and the types of commercial information desired—direct sales, representation, and/or foreign government tenders. As leads are developed by the Foreign Service, they are cabled to Washington, where they are matched by computer against the criteria established by U.S. companies. These leads are then mailed to appropriate U.S. firms within a week of their origination overseas. Trade leads are charged against prepaid subscriptions.

Overseas Product Sales Group

The Overseas Product Sales Group (OPS) provides personalized assistance to TOP subscribers, or to firms identified as having high export capability, in bidding against foreign competitors for specific export sales opportunities with a value of $1 million or more. The OPS specialists collect, inventory and disseminate early information on export sales opportunities from TOP and a variety of other sources.

Foreign Investment Services Staff

The Foreign Investment Services Staff (FISS) is the focal point for American and foreign business inquiries relating to U.S. investment and licensing abroad. American businessmen are assisted in locating potential overseas licensees and partners, are provided with investment data on specific regions and countries, and then guided toward sources of capital for these proposed projects. Foreign investment and licensing proposals for which U.S. participation and technology is sought are published regularly in *Commerce America* and are brought to the direct attention of American firms where appropriate. In carrying out its broad range of activities, FISS works closely with other U.S. Government assistance sources, multinational agencies and private regional investment organizations.

Office of Export Administration

Information on U.S. export control may be obtained from the U.S. Department of Commerce, Bureau of East-West Trade, Office of Export Administration, Washington, D.C. 20230. Telephone: (202) 377-4811.

FINANCING EXPORT SALES

The Export-Import Bank of the United States (Eximbank) is an independent agency of the U.S. Government which works directly with American suppliers and private financial institutions to finance U.S. export sales. Eximbank has numerous financing programs to assist U.S. firms. These include direct loans, bank guarantees, discount loans to commercial banks, leasing guarantees, and other programs to cover overseas design and engineering studies.

Financing packages for major industrial projects and exports of high value products are normally supported under Participation Financing, a combination of the Direct Loan and Financial Guarantee programs.

Direct Loans are dollar credits extended by Eximbank to borrowers outside the United States for purchases of U.S. goods and services. Disbursements under the loan agreement are made in the United States to the suppliers of the goods and services, and the loans, plus interest, are repaid in dollars by the borrowers.

Eximbank will extend its Financial Guarantee to cover loans made by U.S. financial institutions to foreign government or private purchasers of U.S. goods and services. The Financial Guarantee will unconditionally guarantee repayment by a borrower of up to 100% of the outstanding principal due on such loans plus interest equal to the U.S. Treasury rate for similar maturities, plus 1% per annum on the outstanding balances of the loan. Comparable guarantees are available to non-U.S. financial institutions under somewhat different terms.

Of particular importance to U.S. businessmen is Eximbank's Cooperative Financing Facility program which supports medium-term financing in all major markets. Eligible overseas banks are extended a line of credit for half of the funds needed for each transaction, and the cooperating banks provide the other half at local market rates. These banks make credit judgments regarding the customer and can consummate transactions with a minimum of difficulty. Eximbank currently has established approximately 300 such working arrangements with foreign financial institutions (private and public) in over 100 countries.

Eximbank's Commercial Bank Exporter Guarantee program, another activity of special interest to exporters, provides guarantees covering the credit and political risks of nonpayment of medium-term (181 days to 5 years) export debt obligations purchased by U.S. banking institutions on a non-recourse basis from the exporters. The fee charged for Eximbank's guarantee depends upon (1) the classification accorded the country of import, (2) the length of the repayment terms, and (3) the financial condition of the overseas buyer.

As a general rule, all transactions supported by Eximbank must include a minimum 10% cash payment by the buyer and must have reasonable assurance of repayment.

The Bank is directed by statute to supplement and encourage private capital, not compete with it. Selected product lines and services to designated markets are excluded from the agency's support; however, the overwhelming majority of U.S. export products and markets are covered. Details on the exceptions are available from U.S. commercial banks of directly from Eximbank.

Businessmen are specifically invited to utilize Eximbank's counseling services for exporters, banks and financial institutions seeking financing for U.S. exports. The services include information on the availability of financing within the United States and abroad, as well as on each of the pertinent Eximbank programs.

For additional information, contact the Export-Import Bank of the United States, 811 Vermont Avenue, N.W., Washington, D.C. 20571, or Telex 89-461.

EXPORT CREDIT INSURANCE

The Foreign Credit Insurance Association (FCIA) is an association of 53 stock and mutual insurance companies in partnership with the Export-Import Bank of the United States. It offers a comprehensive selection of credit insurance policies which protect policy holders against loss from failure to receive payment from foreign buyers.

The benefits of this coverage may be summed up as follows:

- It protects the exporter against the failure of the buyer to pay his dollar obligation for commercial or political reasons.
- It enables the exporter to offer foreign buyers competitive terms of payment.
- It supports the exporter's prudent penetration of higher risk foreign markets.
- It gives the exporter greater financial liquidity and flexibility in administering his foreign receivables portfolio.

Who May Be Insured

Virtually any corporation, partnership or individual doing business in the United States is eligible for FCIA coverage. An exporter may apply for a policy for himself or may become insured under the blanket policy of a bank or other financial institution which holds an FCIA policy.

Eligible Products

Foreign sales of all types of industrial, agricultural, and commercial products produced in the United States and of services rendered by U.S.-based personnel are eligible for FCIA insurance.

What Losses Are Covered

Comprehensive FCIA policies protect insureds against nonpayment of receivables due to unforeseeable commercial and political occurrences. Commercial risks which are covered include insolvency of the buyer or protracted defaults which may well arise from economic deterioration in the buyer's market area, shifts in demands, unanticipated competition, tariffs, or technological changes. Also covered are defaults due to such buyer problems as increasing expenses, the loss of key personnel, and natural disasters.

Political risks coverage applies to defaults due to governmental action and to political disturbances such as war, revolution, and insurrection. Such events may result in confiscation of the buyer's assets, detention or diversion of shipments, or cancellation of necessary licenses by the United States or by the buyer's country. Also covered is the inability or refusal of the foreign central bank involved to convert the buyer's currency to dollars. Political coverage alone is available for exporters who desire to assume their own commercial risks.

The Policies

The policies offered by FCIA are many and varied. They can be tailored to suit the needs of the individual exporters, service groups, and financial institutions. Aside from a small applicant fee, all premiums are paid only for goods actually shipped.

The Master Policy combines a deductible provision, discretionary credit authority, and once-a-year reporting to provide qualified exporters with lower premiums, independent credit decisions, faster services to overseas buyers, and less paperwork. It is a blanket policy which requires the exporter to insure all or a reasonable spread of his exportation.

The Short-Term Policy is a blanket policy which covers sales on terms of up to 180 days. It provides coverage of 90% for commercial losses and 95% for political losses. A moderate discretionary credit limit is included for each buyer.

The Medium-Term Policy provides 90% coverage (political and commercial) for capital and quasi-capital goods sold on terms of 181 days to 5 years. The policy is written on a case-by-case basis so an exporter need not insure all his medium-term transactions as he would under a blanket policy.

The Combination Policy provides short- and medium-term insurance to protect U.S. exporters in transactions with overseas dealers and distributors. It includes flexible coverage for short-term sales and for both inventory and receivable financing.

The Comprehensive Services Policy insures the receivables generated by the performance of services for foreign customers by U.S.-based personnel, or by U.S. personnel temporarily assigned overseas. Industries benefiting from this coverage include management consultants, engineering and related construction consulting services, and transportation companies.

Special Coverage Endorsements are available in addition to the above policies. These include endorsements to cover specified preshipment risks and consignment selling.

An Aid to Financing

FCIA does not finance export sales. However, the exporter who insures his accounts receivable against commercial and political risks is usually able to obtain financing from commercial banks and other lending institutions at lower rates and on more liberal terms than would otherwise be possible.

Prequalification of Buyers

FCIA's rapidly expanding prequalifying (P.Q.) program is now providing credit information on overseas buyers through its computerized data system. All the exporter needs to do is telephone the nearest FCIA office to determine whether a particular buyer is prequalified for the amount of his purchase.

Information about FCIA

More information about FCIA's services, and applications for policies, may be obtained through insurance agents or brokers or through FCIA's network of ll-service regional offices. General questions and spe- : inquiries may be directed toward the FCIA Ombudsman in the New York office. Cal (213) 432-6216 for a direct connection.

FCIA Offices

One World Trade Center—9th Floor
New York, New York 10048
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Country Marketing Managers

Commercial and economic information on most trading partners of the United States is available from the Bureau of International Commerce, U.S. Department of Commerce.

The Bureau is organized geographically with a Country Marketing Manager responsible for a country or group of countries as listed below. Assistance or information about marketing in these countries may be obtained by dialing these key people directly: **202-377** plus the given extension.

Area	**Extension**
Africa (sub-Sahara)	4927
Europe	
France and Benelux Countries	4504
Germany and Austria	5228
Italy, Greece and Turkey	3944
Nordic countries	3848
Spain, Portugal, Switzerland and Yugoslavia	2795
United Kingdom and Canada	4421
Far East	
Australia and New Zealand	3646
East Asia and the Pacific	5401
Japan	2425
South Asia	2522
Latin America	
Brazil, Argentina, Paraguay and Uruguay	5427
Mexico, Central America, and Panama	2314
Remainder of South America and Caribbean countries	2995

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Commerce Action Group for the Near East

North Africa	5737
Near East	
Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Peoples Democratic Republic of Yemen, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen Arab Republic	5767
Iran, Israel, Egypt	3752

Bureau of East-West Trade

Eastern Europe	2645
USSR	4655
Peoples Republic of China	3583

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